DOCUMENT RESUME

ED 240 323 CE 038 197

AUTHOR	Perky, Sandra Dutreau; And Others
TITLE	Highway Maintenance Equipment Operator. Miscellaneous Equipment. Training Materials.
INSTITUTION	Oklahoma State Board of Vocational and Technical Education, Stillwater. Curriculum and Instructional Materials Center.
PUB DATE	83
NOTE	265p.; For a related document, see CE 038 196. Developed in cooperation with the Kansas Department of Transportation, the Oklahoma Department of Transportation, and the New Mexico Highway Department.
AVAILABLE FROM	Curriculum and Instructional Materials Center, Oklahoma State Board of Vocational and Technical Education, 1515 West Sixth Avenue, Stillwater, OK 74074 (Teacher--$15.00, Student--$23.00).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Adult Vocational Education; Behavioral Objectives; Competency Based Education; Curriculum Guides; Equipment; *Equipment Maintenance; *Equipment Utilization; *Highway Engineering Aides; *Job Training; Learning Activities; Postsecondary Education; Refresher Courses; Retraining; *Road Construction; Safety; Tests; *Trade and Industrial Education; Transparencies; Units of Study
IDENTIFIERS	*Highway Maintenance

ABSTRACT

This curriculum guide provides instructional materials to assist in training equipment operators in the safe and effective use of highway maintenance equipment. It includes six units of instruction covering the small, specialized equipment used in maintenance operations. Each unit of instruction consists of eight basic components: performance objectives, teacher activities, information sheets (content essential for meeting the cognitive objectives), assignment sheets (applications of knowledges that are prerequisites to skill development), job sheets (procedures to complete a manipulative or psychomotor skill), transparency masters, tests, and test and assignment sheet answers. Six pieces of equipment are included: oxyacetylene cutting equipment, air compressors and attachments, sweepers, concrete saws, spray equipment, and sandblaster and hydroblaster. For each piece of equipment, this manual covers uses, operation, application, and safety procedures. The materials are suitable for students who are new employees, seasoned operators upgrading skills, or skilled operators reviewing procedures and using these materials for reference. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED240323

Highway Maintenance Equipment Operator

Miscellaneous Equipment

TRAINING MATERIALS

Written by

Sandra Dutreau Perky, Curriculum Writer
State Department of Vocational and Technical Education
Stillwater, Oklahoma

Joe C. Phipps, Technical Consultant
State Department of Vocational and Technical Education
Stillwater, Oklahoma

Greg Pierce, Assistant Coordinator
State Department of Vocational and Technical Education
Stillwater, Oklahoma

Developed as a cooperative project by the
Kansas Department of Transportation
John B. Kemp, Secretary of Transportation
Oklahoma Department of Transportation
Richard A. Ward, Director and Chief Engineer
New Mexico Highway Department
Joe Hewett, Chief Highway Administrator

and
Oklahoma State Board of Vocational and Technical Education
Leslie Fisher, Chairman
Francis T. Tuttle, Director
Bob Patton, Coordinator, Curriculum and Instructional Materials Center

CE 038 197

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Ts D Frazier

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

84-002010

Copyright 1983
Oklahoma State Department of Vocational and Technical Education
Curriculum and Instructional Materials Center

All rights reserved.

Printed in the United States of America by the
Oklahoma State Department of Vocational and Technical Education
Stillwater, Oklahoma 74074

This publication, or parts thereof, may not be reproduced in any form by photographic, electrostatic, mechanical, or any other method, for any use including information storage and retrieval, without written permission from the publisher.

Use of commercial products in these instructional materials does not imply endorsement by the Oklahoma State Department of Vocational and Technical Education.

The Oklahoma State Department of Vocational and Technical Education does not discriminate on the basis of race, creed, color, national origin, sex, age, veteran status, or qualified handicap.

HIGHWAY MAINTENANCE EQUIPMENT OPERATOR

MISCELLANEOUS EQUIPMENT

TABLE OF CONTENTS

Unit I — Oxyacetylene Cutting Equipment 1

Unit II — Air Compressors and Attachments 45

Unit III — Sweepers 111

Unit IV — Concrete Saw 155

Unit V — Spray Equipment 197

Unit VI — Sandblaster and Hydroblaster 229

4

FOREWORD

In 1981, as an effort to provide high-quality and uniform training materials, the Departments of Transportation in Oklahoma and Kansas and the New Mexico Highway Department entered into an agreement with the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, to develop a curriculum for equipment operators in highway maintenance. *Highway Maintenance Equipment Operator: Miscellaneous Equipment* is the third of three books printed as a result of the cooperative effort.

Within this consortium, administrators, supervisors, operators, and writers collaborated closely to produce materials that will provide each student with information and practical learning experiences directly applicable to maintenance operations. Whether the students are new employees, seasoned operators upgrading skills, or skilled operators reviewing procedures and using these materials for reference, they can appreciate the expertise of the people who created *Highway Maintenance Equipment Operator.*

The information in *Highway Maintenance Equipment Operator: Miscellaneous Equipment* has been selected to apply generally to highway maintenance training programs, and should be adapted and modified to coincide with departmental policy, specifications, and objectives.

It is my sincere hope that *Highway Maintenance Equipment Operator* will contribute to the development of a competent, safety-conscious work force in maintenance operations across the country. Also, I hope that the dedication and active interest repeatedly shown by highway department representatives and employees carries through this publication from teacher to student and, through craftsmanship and care, to the highway-traveling public.

Francis Tuttle, Director
Oklahoma State Department of
Vocational and Technical Education

PREFACE

This curriculum was designed and prepared especially for equipment operators in highway maintenance. From gravel roads to multilane urban interstates, it is the responsibility of maintenance teams to maintain the roadways and rights-of-way in a condition safe for public and commercial use. Therefore, the purpose of these materials is to assist in training those teams in the safe and effective use of maintenance equipment.

In *Highway Maintenance Equipment Operator: Miscellaneous Equipment*, students learn the uses, operation, application, and safety procedures for small, specialized equipment such as oxyacetylene cutting equipment and sandblasting equipment. Using such specialized equipment, one or two persons may perform the entire maintenance operation.

Safety cannot be too strongly stressed. We have made every effort to ingrain a safety-conscious attitude as the operator's first and foremost responsibility. Departmental safety manuals should be provided for each student and should be incorporated into the teaching of each unit.

We realize that departmental policy and available materials will vary with each training program, and we urge you to make whatever modifications are necessary and desirable to meet your own circumstances and objectives.

For the instructor, *Highway Maintenance Equipment Operator: Miscellaneous Equipment* offers a systematic presentation of information, written and applied exercises, and evaluation procedures. It is not intended that the units in this manual stand alone, but that they be enhanced with additional materials and with the instructor's own methods, experience, and enthusiasm.

Sandra Dutreau Perky, Curriculum Writer
Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and Technical Education

Greg Pierce, Assistant Coordinator
Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and Technical Education

ACKNOWLEDGEMENTS

Appreciation is expressed to the many individuals and companies who gave their time, talents, and knowledge in the preparation of this publication.

Committee Members

Larry Buie
Maintenance Engineer
Division 6
Oklahoma Department
of Transportation
Buffalo, Oklahoma

Bill Jessee
Maintenance Superintendent
District 4
Kansas Department
of Transportation
Pittsburg, Kansas

Gary Ridley
Maintenance Superintendent
Division 4
Oklahoma Department
of Transportation
Perry, Oklahoma

Steve Woolington
Operations Engineer
Management Services Department
Kansas Department
of Transportation
Topeka, Kansas

Recognition and appreciation are also due to Veronica Gomez, Wes Hibner, and Orlando Lucero of the New Mexico Highway Department for their assistance in the early stages of this project; and also to Anne P. Reamon and Noble Morrell of the Kansas Department of Transportation, and Jon Powell of the Oklahoma Department of Transportation for facilitating development.

A special thanks and acknowledgement for the information, input, and friendship of the technical consultant for *Highway Maintenance Equipment Operator:*

Joe C. Phipps, Ret.
Coordinator, Maintenance Division
District 5
New Mexico Highway Department
Santa Fe, New Mexico

And thanks to Gary Ridley, Maintenance Supervisor, Division 4, Oklahoma Department of Transportation, for his many contributions in time, equipment, and personnel.

A grateful thank-you goes to Laborn J. "Bud" Hendrix, who patiently provided much information and guidance for this manual.

It is with deep respect that I thank the employees of the Oklahoma Department of Transportation for sharing their time and experience. They are skilled, dedicated, enthusiastic people who take pride in their work. It has been a pleasure and an honor to be associated with them.

Tim Clark
Jim Cross
Danielle Keith
Larry Koch
Joe Hogan
John Melvin
John Robbins
Roy Rogers
Leroy Schlehuver
Tom Wadley

The production staff is grateful to the following companies for their extensive technical support.

Binks Manufacturing Company, Franklin Park, Illinois; The Broyhill Company, Dakota City, Nebraska; Hydroblaster, Incorporated, Sparks, Nevada; and Lonnie Cargill of Oklahoma State University Extension Services, Stillwater, Oklahoma

PRODUCTION STAFF

The production staff includes many people in Graphics Division whose names I do not know, but whose work I recognize and appreciate in word processing, art, and printing.

The fine talented hand of Kim Hale prepared the artwork for this project; Joan Henderson was the photographer; Claire Dickey processed film and photos.

Many thanks to Terra McCluskey and her editing staff, who have polished and finished my rough work. My time with them has been enjoyable and instructive. Thank you, Lynne Murnane, Susan Walker, Terri Perry, Jerry Weir, Sue Buck, Barbara Harrison, Sue Feasley, and Marla Hamilton.

And thanks for special favors from Jane Smola, Susan Hedrick, Sandra Lewis, and my secretary, Suzanne Perry.

For their support and input, I am indebted to Joyce Sawatzky, Robert Hilley, and Sarah Mussett, who all worked closely with me at CIMC.

My deepest gratitude and appreciation go to Greg Pierce, who gathered support, personnel, and resource materials for *Highway Maintenance Equipment Operator.* He did a good job as teacher and supervisor, patching the rough spots in the road as I arrived at them. It has been a pleasure and a privilege to work with him.

And to you who are learning or upgrading your skills in highway maintenance, a sincere and special thanks. Few people have the opportunity I have had to know how important and demanding your work is. I am happy and grateful that I can contribute to your safety and growth.

Sandra D. Perky, Curriculum Writer
Curriculum and Instructional Materials Center

Instructional Units

Highway Maintenance Equipment Operator: Miscellaneous Equipment includes six units of instruction. The format used by the Oklahoma CIMC includes eight basic components that form a unit: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may be transparency masters, assignment sheets, or job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help him or her determine the following

A. Amount of material that can be covered in each class period
B. Skills that must be demonstrated
    1. Supplies and equipment needed
    2. Amount of practice needed
    3. Amount of class time needed for demonstrations
C. Supplementary materials, such as pamphlets and filmstrips, that must be ordered
D. Resource people who must be contacted

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction, and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching/learning process, it is important that teachers and students have a common understanding of the intent of the objectives. Following is a list of performance terms, their meanings, and behavioral synonyms that may have been used in this material.

A. Name — The individual supplies a name for objects, events, or people

    Behavioral synonyms: Label, list, letter, record, reiterate, repeat, write

B. Identify — The individual selects a named, described, or pictured object by pointing to it, touching it, picking it up, or selecting it

    Behavioral synonyms: Select, mark, match, choose, judge

C. State a rule — The individual communicates a relationship or principle that could be used to solve problems or perform a task

D. Apply a rule — The individual supplies an answer to a problem by using a stated relationship or principle

Behavioral synonyms: Solve, calculate

E. Describe — The individual relates sufficient characteristics or properties of an object or event so that a second individual will be able to state what is being discussed

Behavioral synonyms: Define, discuss, interpret, recite, tell how, tell what happens when

F. Distinguish — The individual selects an object or event from two or more that are easily confused

Behavioral synonyms: Discriminate, differentiate

G. Order — The individual arranges three or more objects or events in a sequence based on a stated property

Behavioral synonyms: Arrange, sequence, list in order, classify, divide, isolate, sort

H. Construct — The individual makes a physical object, a verbal statement, or a drawing

(NOTE: *Construct* is used when the finished product or result is important.)

Behavioral synonyms: Draw, make, build, design, formulate, reproduce, transcribe, convert, put together, compile

I. Demonstrate — The individual performs several operations necessary to carry out a specified process

(NOTE: *Demonstrate* is used when it is desirable to watch the student perform a task, one of the highest levels of student performance.)

Behavioral synonyms: Show your work, show procedure, perform an experiment, perform the steps, operate, remove, replace, turn off/on, (dis)assemble, (dis)connect

The objectives should be provided for students and stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine prior knowledge of students and to determine whether further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages)

This component is included only in teacher material. The suggested activities page assists teachers during the preparation stage of the teaching/learning process by providing suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audio-visual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed are ones used in the development of each unit. They should be used by the teacher to supplement knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Transparency Masters (white pages in teacher material and green in student material)

Transparency masters provide information in a special way. Transparencies direct the class' attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification is necessary. Transparencies should be made and placed in the notebook where they will be immediately available for use.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience with the information. They assist students in the application of knowledges that are necessary prerequisites to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided when appropriate and can be used by the student and/or teacher for checking student progress.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomoter skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

A teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Tests (yellow pages)

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pericil and performance objectives must be evaluated.

The tests may be written or oral. It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test — 85 percent in most units — may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final unit grade should be obtained by using the paper/pencil score along with teacher evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

These components are designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center is assigned a specific abbreviation. For example, *Highway Maintenance Equipment Operator: Miscellaneous Equipment* has been abbreviated DOT III. An example of a page number is DOT III-1. Because CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

Material may be given out a unit or page at a time to keep the material before the student always new. Some teachers ask students to furnish a three-ring binder for the units. This is more convenient for taking the materials home to study. Upon completion, each unit is placed in a larger binder. The large binders may be purchased at cost from the CIMC. Some teachers store the materials by units in filing cabinets or boxes until needed. All the units may be given out at once if desired.

For best results, provide student materials for each student. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. All tests are collated at the back of student material and should be removed and stored until needed. Students should be allowed to take their materials home at the end of the year.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to set up, light, adjust, and use an oxyacetylene cutting outfit. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with oxyacetylene cutting to their correct definitions.
2. State color codes for oxygen and acetylene.
3. Arrange in order stages in the oxygen-acetylene cutting process.
4. Identify the parts of an oxyacetylene cutting outfit.
5. Identify the parts of a torch body and cutting attachment.
6. State safety rules for working with oxygen and acetylene equipment.
7. Identify types of oxyacetylene cutting flames.
8. Arrange in order steps to follow in case of flashback.
9. Select from a list causes of backfire.
10. Distinguish between flashback and backfire.
11. Identify a multiflame heating nozzle (rosebud) and tip.
12. Describe uses of a multiflame heating nozzle (rosebud).
13. Demonstrate the ability to
    a. Set up equipment for oxyacetylene cutting.
    b. Turn on, light, adjust to a neutral flame, and turn off oxyacetylene cutting equipment.
    c. Cut mild steel at a 90-degree angle, stop, and restart the cut.
    d. Cut round stock.
    e. Cut cable.

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order films and other materials to supplement unit.

1. Films

a. *Flame Cutting.* Color, 20 minutes, MacMillan Films, 1972. Available from MacMillan Films, 34 MacQuester Parkway South, Mount Vernon, New York 10550, 914/664-5051.

(NOTE: This film provides step-by-step instructions for making straight-line cuts, cutting irregular shapes, beveling plate edges, and making circle cuts. It gives excellent instructions on freehand cutting and oxyacetylene cutting torch.)

b. *The Cutting Torch--Flame Cutting.* Color, 18 minutes, BFA Educational Media, 1972. Available from BFA Educational Media, 468 Park Avenue South, New York, New York 10016, 212/684-5910.

(NOTE: This film covers the many aspects of tip selection and the procedures for using the torch.)

c. *Don't Push Your Luck.* Color, 12 minutes, Harvest Films, 1978. Available from Harvest Films, Inc., 309 5th Avenue, New York, New York 10016, 212/648-7950.

(NOTE: Bill Frank, the actual victim, recreates his real-life blinding accident. He delivers to employees a powerful safety message on face and eye protection.)

2. Slide/cassette programs

a. *There's Something in the Air.* 30 slides with cassette, National Safety Council, n.d. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, 312/527-4800.

(NOTE: This program tells workers how to protect themselves from contaminated air--fogs, mists, fumes, gases, smokes, sprays, and vapors--that could be harmful to their lungs.)

SUGGESTED ACTIVITIES

b. *Oxyacetylene Cutting Explained.* Two color filmstrips, 2 cassettes, 12-13 minutes each, Bergwall Productions, Inc. May be purchased from Bergwall Productions, 839 Steward Avenue, P.O. Box 238, Garden City, New York 11530, call toll-free 800/645-3565.

(NOTE: Part 1, *Setting up Equipment,* explains cutting operation: cutting tip, attaching tip to torch body, lighting and testing flame, purging the line and shutting down the unit. Part 2, *Specialized Oxyacetylene Cutting,* demonstrates torch angle, correct cutting procedure, lighting and testing the flame, cutting thin and heavy stock, chamfering, constructing and using guide for cutting a circle, and piercing stock.)

B. Make transparencies.

C. Provide students with objective sheet.

D. Provide students with information and job sheets.

E. Discuss unit and specific objectives.

F. Discuss information sheet.

G. Demonstrate and discuss procedures outlined in job sheets.

H. Provide alternate jobs if those in job sheets are not practical.

I. Arrange a field trip for students to observe flame cutting equipment and operations.

J. Contact local welding supplier for materials on cutting techniques, pressurized gas, safety equipment, and other items of interest.

K. Get color flame charts from welding supplier to show types of flames.

L. Have students demonstrate the ability to use equipment safely and according to the recommended uses.

M. Review first aid for burns.

N. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

SUGGESTED ACTIVITIES

D. Transparency masters

1. TM #1--Oxygen Regulator Gauges
2. TM #2--Acetylene Regulator Gauges

E. Job sheets

1. Job Sheet #1--Set Up Equipment for Oxyacetylene Cutting
2. Job Sheet #2--Turn On, Light, Adjust to a Neutral Flame, and Turn Off Oxyacetylene Cutting Equipment
3. Job Sheet #3--Cut Mild Steel at a 90-Degree Angle, Stop, and Restart the Cut
4. Job Sheet #4--Cut Round Stock
5. Job Sheet #5--Cut Cable

F. Test

G. Answers to test

III. Unit reference--Hendrix, Laborn J. "Bud." *Millwright Instructional Materials,* Volume 1. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and Associated General Contractors of America, 1980.

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Acetylene--Colorless, gaseous hydrocarbon used in cutting

(NOTE: Other gases are also used in cutting.)

B. Oxygen--Element that is normally a colorless, odorless, and tasteless gas; used in combination with other substances in cutting

C. Oxyacetylene cutting--Flame cutting of metal in which the preheating of the metal is accomplished with a flame produced by an oxyacetylene torch

D. Purge--To remove any foreign material from a system or component by flushing with the gas used in that system

E. psi--Pounds per square inch

F. Combustible--Capable of burning

G. Toxic--Poisonous

H. Journal--That part of a shaft, axle, or spindle that turns in a bearing

I. Flint lighter--Striker used to ignite torch

J. Slag box--Metal container with a layer of water or sand to catch hot material

K. Slag--Metal that melts away during the oxyacetylene cutting process

L. Seizing--Firmly binding cable with soft iron wire

II. Color codes for oxygen and acetylene

A. Oxygen--Green

B. Acetylene--Red

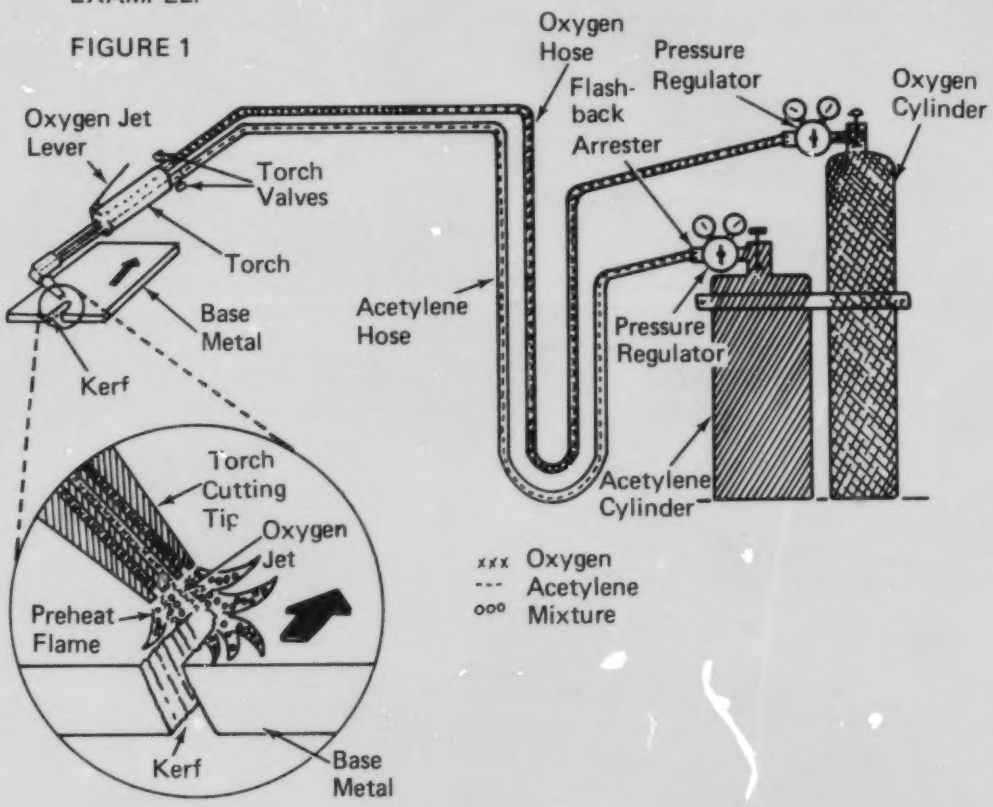
INFORMATION SHEET

III. Stages in the oxygen-acetylene cutting process (Figure 1)

(NOTE: A flame of oxygen mixed with acetylene [or other fuel gas] heats the base metal; then an oxygen jet cuts the heated metal. Oxyacetylene cutting is one of the most popular methods of cutting and shaping steel.)

EXAMPLE:

FIGURE 1



A. Pressure-regulated acetylene and pressure-regulated compressed oxygen are supplied from two cylinders

(NOTE: Each cylinder has two pressure gauges. The cylinder pressure gauge indicates pressure in the cylinder [high], and the working pressure gauge indicates the pressure of the gas being fed to the torch [low].)

B. Separate, flexible hoses carry gases to torch

(NOTE: Two needle valves control the flow of gas.)

C. Operator ignites acetylene gas with spark from flint lighter

D. Operator opens oxygen torch valve, and gases are mixed inside torch

INFORMATION SHEET

E. Mixture burns at several orifices in torch tip (preheat orifices)

F. Flame heats base metal to a dull, cherry red

G. Operator presses oxygen lever, and jet of oxygen rushes out of cutting orifice

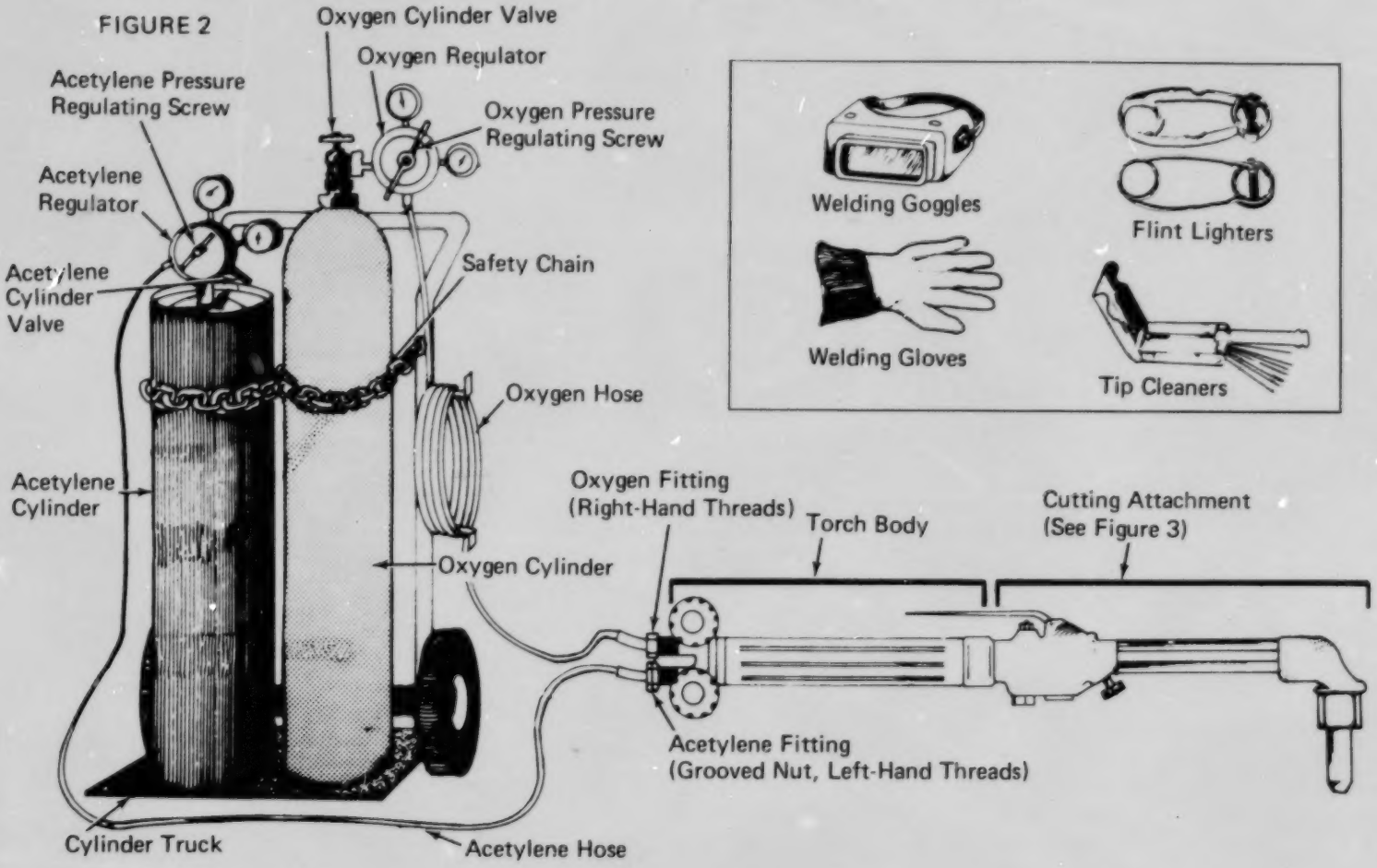
H. Oxygen jet quickly oxidizes the heated base metal and blows it away

I. Removal of material leaves a cut in the metal

INFORMATION SHEET

IV. Parts of an oxyacetylene cutting outfit (Figure 2; Transparencies #1 and #2; Job Sheet #1)

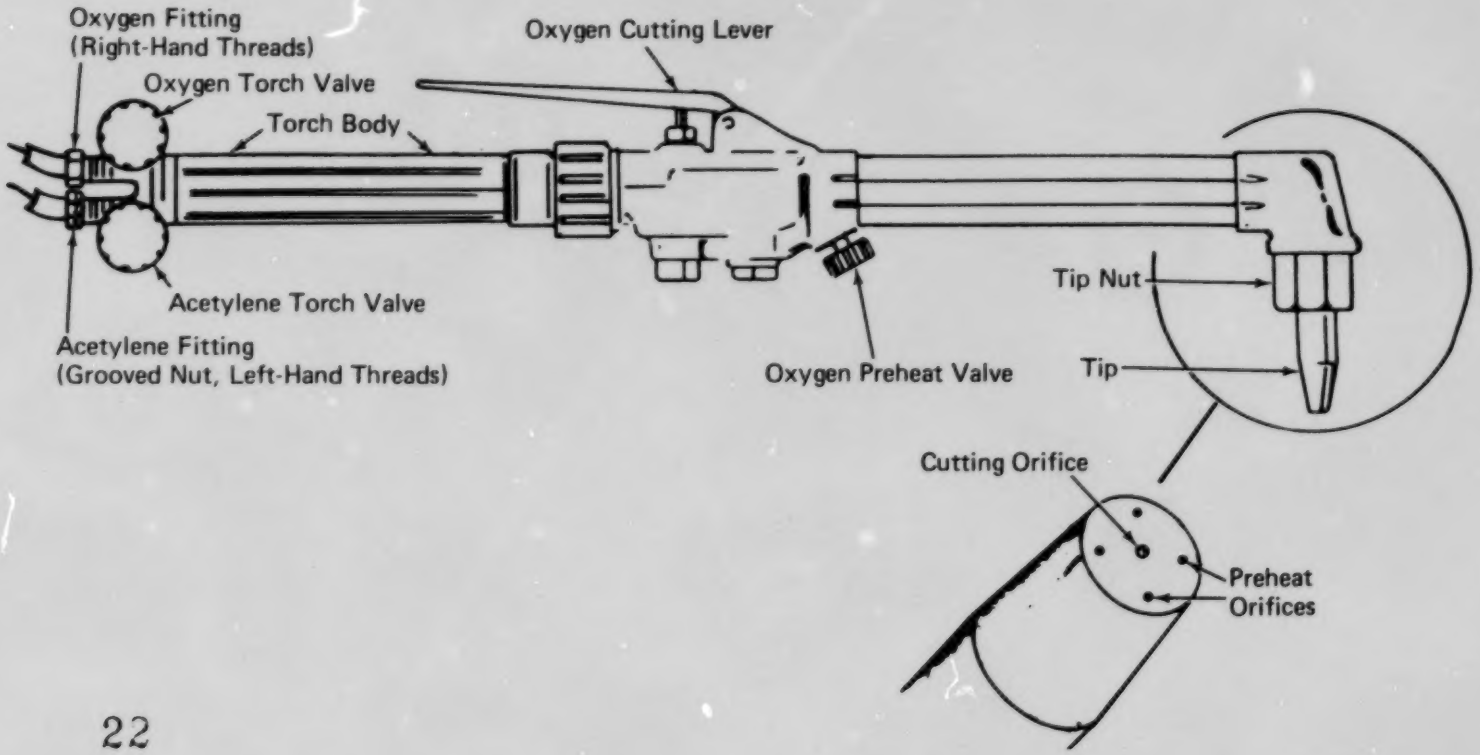
FIGURE 2



V. Parts of a torch body and cutting attachment (Figure 3)

(NOTE: The preheat orifices heat metal to a kindling point of approximately 1600°F. The cutting orifice removes oxidized metal.)

FIGURE 3



INFORMATION SHEET

VI. Safety rules for working with oxygen and acetylene equipment (Job Sheets #1-#5)

(NOTE: Instructor may add other safety rules. The chief dangers of oxyacetylene cutting are burns and toxic fumes. Pay attention at all times and notice how you feel.)

(CAUTION: If you feel dizzy or nauseated, or if you have blurred vision, stop cutting and get some fresh air.)

A. Make sure that either a foam or a multipurpose dry-chemical fire extinguisher is readily available and in working condition

B. Wear welding goggles, gloves, and protective clothing

(CAUTION: Keep gloves, hands, and clothing free of oil and grease.)

C. Wear gloves to handle hot metal

D. Use open torch only in a well-ventilated place

E. Avoid breathing toxic fumes

EXAMPLES: Galvanized metal fumes, some paint fumes

F. Do not leave a burning torch unattended

G. Secure cylinders in a safe place

(NOTE: Secure cylinders to protect valves and regulators and to prevent injuries.)

H. Cut or weld at least 5 feet from cylinders

I. Always use regulators; do not use oxygen or acetylene directly from cylinders

(NOTE: Be sure regulators are used only on the cylinders that they were designed to be used on.)

J. Use flint lighters, *not matches,* for lighting torch

K. Use hoses designated for oxygen and acetylene only

L. Do not use oil on regulators, torches, fittings, or any equipment surface that may come in contact with oxygen

(CAUTION: Never oil or grease oxygen fittings. Substances will unite with a violent explosion!)

M. Do not use compressed oxygen to clean off clothing

(CAUTION: Do not confuse compressed oxygen with compressed air. Oxygen speeds up combustion, and oxygen-soaked clothing needs only a spark to burst into flame.)

N. Do not breathe compressed oxygen directly from cylinder or hose

INFORMATION SHEET

O. Use soap and paintbrush to test connections for leaks

P. Do not use acetylene at pressures higher than 15 pounds per square inch

(CAUTION: Acetylene becomes unstable and highly explosive when pressure is over 15 psi.)

Q. Do not cut or weld directly on gravel or concrete

R. Keep heat, flames, and sparks away from combustibles

S. Do not cut or weld on containers that have been used to store combustible materials unless containers have been properly cleaned and purged

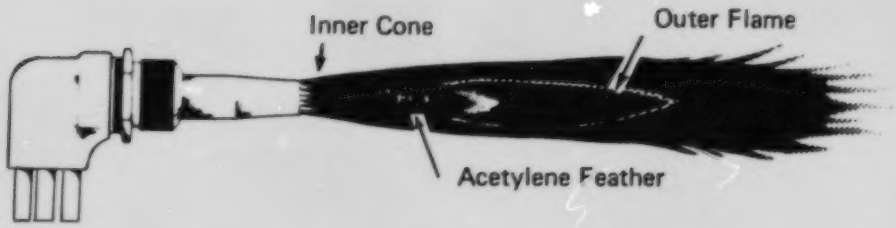
EXAMPLES: Containers that have held gases such as nitrogen, carbon dioxide, or argon

VII. Types of oxyacetylene cutting flames (Figures 4-6; Job Sheets #2-#5)

A. Carburizing flame

(NOTE: The flame illustrated has an excess of acetylene gas.)

FIGURE 4

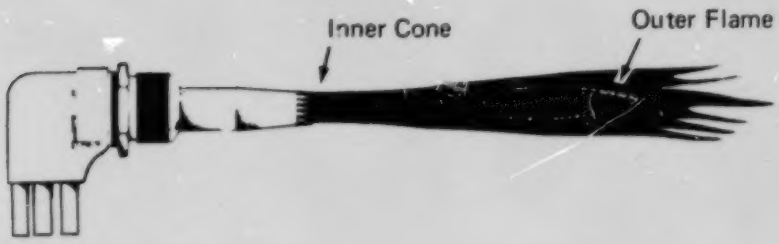


INFORMATION SHEET

B. Neutral flame

(NOTE: The flame illustrated has the proper ratio of oxygen to acetylene.)

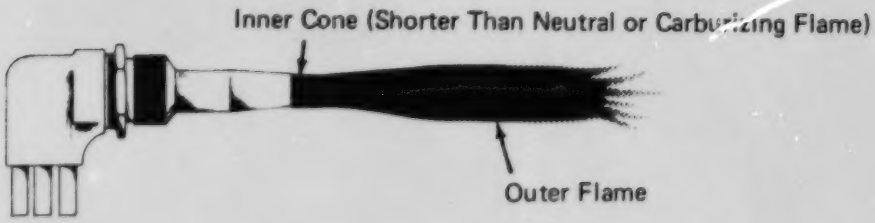
FIGURE 5



C. Oxidizing flame

(NOTE: The flame illustrated has an excess of oxygen.)

FIGURE 6



INFORMATION SHEET

VIII. Steps to follow in case of flashback

A. Close oxygen preheat valve

B. Close oxygen torch valve

C. Close acetylene torch valve

D. Release oxygen regulator screw

E. Release acetylene regulator screw

F. Examine acetylene unit

G. Reset regulator pressures

H. Light torch

(NOTE: If heavy smoke comes out of the torch tip and the torch body becomes hot, the flashback has probably traveled past the mixing chamber into the hose. In this case, shut off the oxygen and acetylene cylinder and then notify the supervisor.)

IX. Causes of backfire

(NOTE: The causes listed below should be carefully checked to control backfire.)

A. Not enough acetylene or oxygen pressure for the tip size used

B. Loose cutting tip

C. Dirty tip

(NOTE: Tip may have deposits or metal particles inside orifice. These deposits may overheat and act as ignitors.)

D. Overheating of cutting tip

E. Bad O-ring in torch body

X. Differences between flashback and backfire

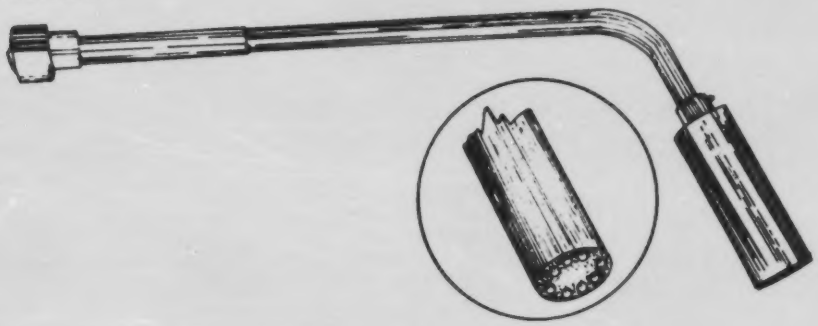
A. Flashback--Flame disappears inside torch body; at the same time, a squealing noise occurs and smoke and/or sparks are emitted from the torch tip

B. Backfire--Flame burns momentarily back into tip; then a loud snap or pop is emitted from the torch and the flame either goes out or continues to burn in a normal manner

INFORMATION SHEET

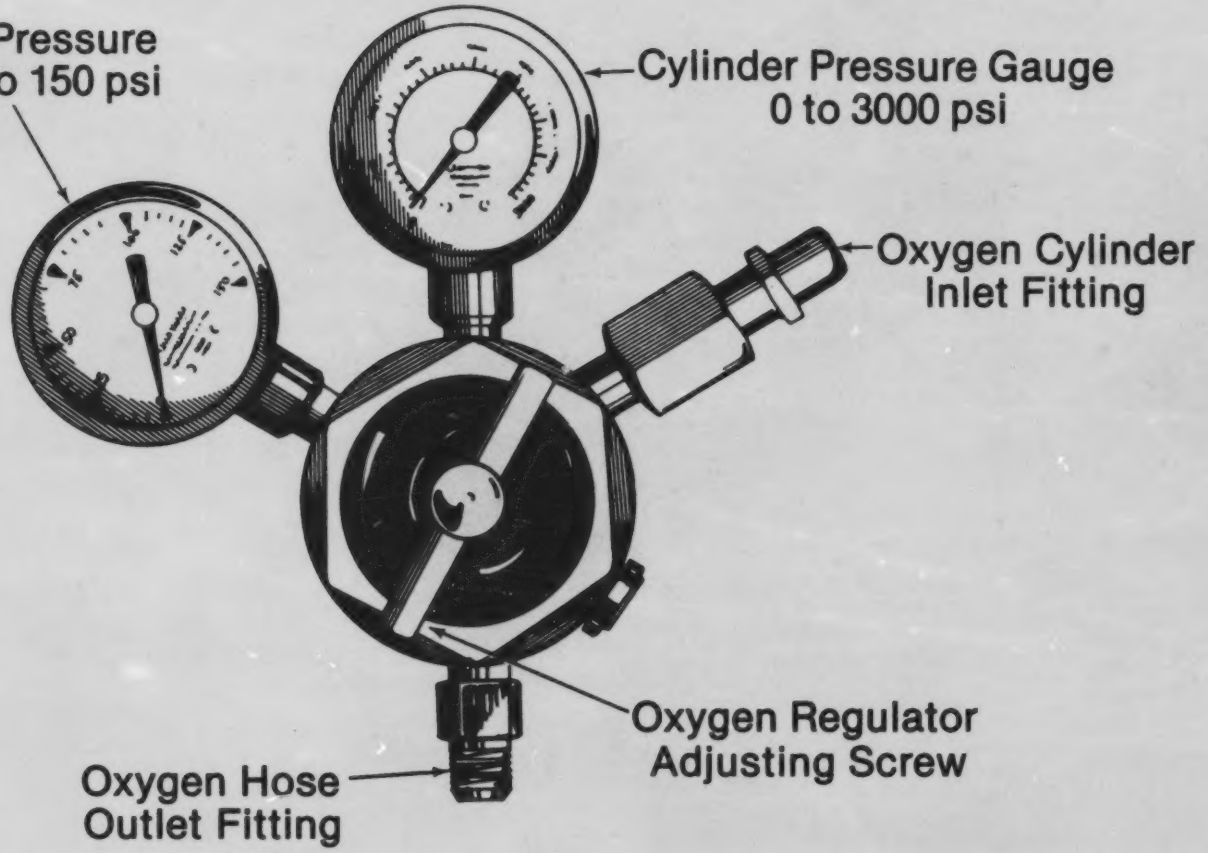
XI. Multiflame heating nozzle (rosebud) and tip (Figure 7)

FIGURE 7

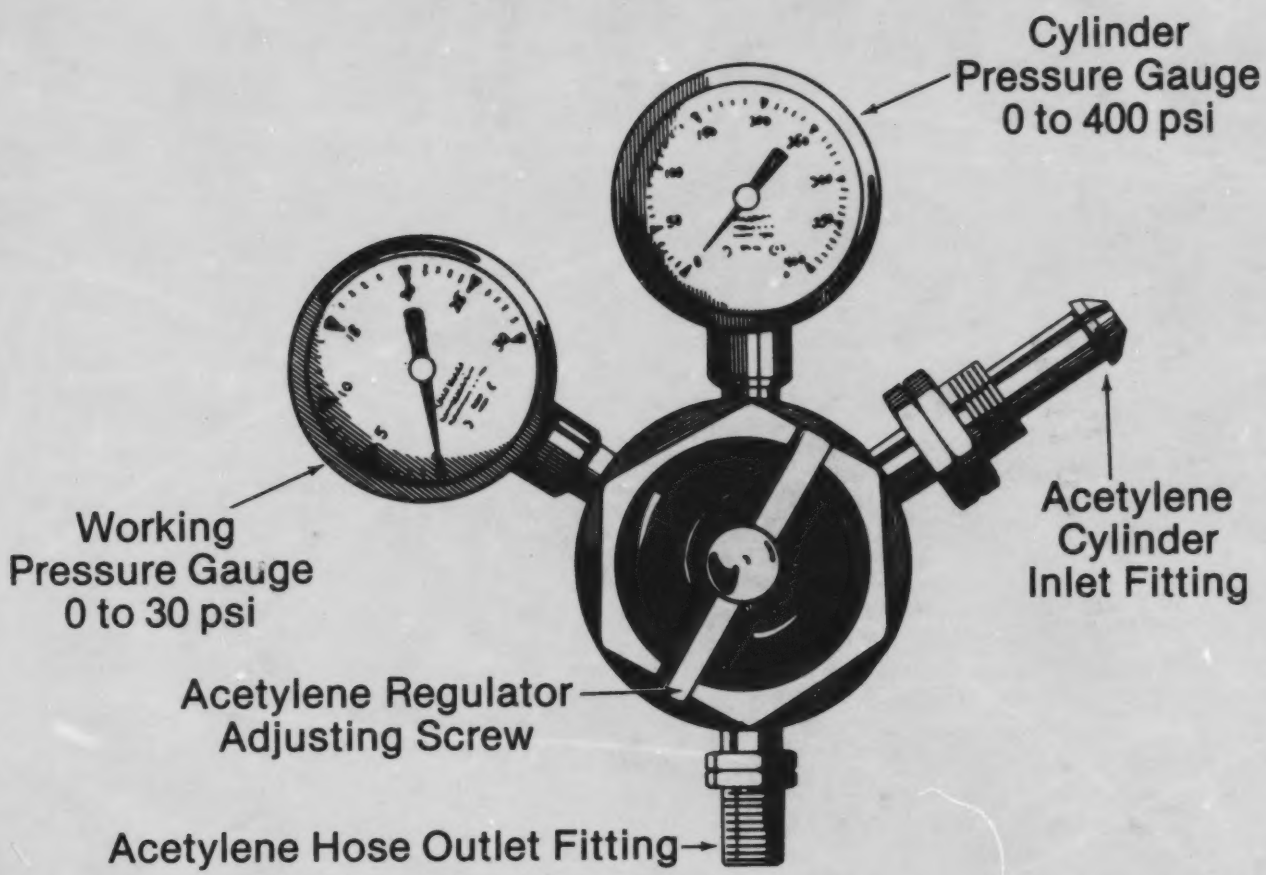


XII. Uses of a multiflame heating nozzle (rosebud)--Used to heat parts and/or metals, such as bearings, before fitting them to the journal; also used to preheat metal before welding

Oxygen Regulator Gauges



Acetylene Regulator Gauges



OXYACETYLENE CUTTING EQUIPMENT
UNIT I

JOB SHEET #1--SET UP EQUIPMENT FOR OXYACETYLENE CUTTING

I. Equipment and materials

A. Oxygen cylinder

B. Acetylene cylinder

C. Oxygen regulator

D. Acetylene regulator

E. Hoses

F. Wrench

G. Cylinder holder

H. Foam or multipurpose dry-chemical fire extinguisher

I. Soap

J. Clean paintbrush

K. Torch body with tips

L. Welding goggles

II. Procedure

A. Fasten cylinders in a vertical position on cylinder holder

(CAUTION: To prevent damage to valves, never use acetylene from a cylinder that is not in a vertical position. Valve damage might cause cylinder to explode.)

B. Remove caps from cylinders

C. Crack valves of each cylinder to remove foreign material; close valves

D. Connect oxygen regulator to oxygen cylinder

(CAUTION: Do not use oil or any thread compound on any connections in the oxyacetylene system.)

1. Turn adjusting screw on regulator counterclockwise until tension on spring is released

2. Slowly turn cylinder valve wide open

JOB SHEET #1

E. Connect acetylene regulator to acetylene cylinder

1. Turn adjusting screw on regulator counterclockwise until tension on spring is released

2. Open cylinder valve one-half to three-quarters of a turn

(NOTE: Never open cylinder valve more than one and one-half turns. Leave wrench with cylinder)

F. Connect acetylene hose to acetylene regulator; purge hose

G. Connect oxygen hose to oxygen regulator; purge hose

H. Connect torch body to oxygen and acetylene hoses

I. Close both valves on torch body

J. Attach cutting attachment to torch body

(NOTE: The tip size is determined by the thickness of metal to be cut and the manufacturer's instructions.)

K. Close oxygen preheat valve on cutting attachment

L. Turn adjusting screw on oxygen regulator clockwise until working pressure is reached

M. Turn adjusting screw on acetylene regulator clockwise until correct working pressure is reached

(CAUTION: At pressures higher than 15 psi, acetylene becomes unstable and highly explosive.)

N. Use dishwashing soap to test all connections for leaks

(NOTE: Apply soapsuds with a clean paintbrush.)

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

JOB SHEET #2--TURN ON, LIGHT, ADJUST TO A NEUTRAL FLAME, AND TURN OFF OXYACETYLENE CUTTING EQUIPMENT

I. Equipment and materials

- A. Oxyacetylene cutting outfit
- B. Wrench
- C. Welding gloves
- D. Welding goggles
- E. Coveralls or protective clothing free from oil and grease
- F. Flint lighter
- G. Foam or multipurpose dry-chemical fire extinguisher
- H. Tip cleaners

II. Procedure

- A. Check all cylinder, regulator, and torch valves to make sure that they are closed
- B. Open acetylene cylinder valve one-half to three-quarters of a turn

  (CAUTION: Never open cylinder valve more than one and one-half turns.)
- C. Open acetylene valve on torch one turn
- D. Turn adjusting screw on acetylene regulator clockwise until desired pressure is reached

  (NOTE: Oxygen and acetylene pressures and size of tip depend upon the thickness of metal to be cut. Use pressures and tip size recommended by manufacturer.)

  (CAUTION: Acetylene becomes unstable and highly explosive at pressures higher than 15 psi.)
- E. Close acetylene valve on torch
- F. Open oxygen cylinder valve all the way
- G. Open oxygen torch valve all the way
- H. Open oxygen preheat valve on cutting attachment one turn
- I. Turn adjusting screw on oxygen regulator clockwise until desired pressure is reached
- J. Close oxygen preheat valve on cutting attachment

JOB SHEET #2

K. Open acetylene valve on torch one-quarter turn

L. Light torch with flint lighter and adjust until smoke on flame clears

(NOTE: Clean tips before lighting torch and as often as needed during cutting operation.)

M. Open oxygen preheat valve slowly and adjust to a neutral flame

N. Depress oxygen cutting lever and check to see that a neutral flame is present

(NOTE: If necessary, adjust the oxygen preheat valve with the oxygen cutting lever depressed until a neutral flame is secured. Pressure rises slightly when valve is closed.)

O. Close acetylene valve on torch

P. Close acetylene cylinder valve

Q. Close oxygen preheat valve

R. Close oxygen cylinder valve

S. Open acetylene valve on torch

(NOTE: When gauges reach zero, close torch valve and release adjusting screw on acetylene regulator by turning counterclockwise.)

T. Open oxygen preheat valve on torch

(NOTE: When gauges reach zero, close oxygen preheat valve and turn adjusting screw on oxygen regulator counterclockwise.)

U. Close oxygen valve on torch

V. Place torch and hose on hanger or brackets provided

(NOTE: If regulators are removed from cylinders, replace the caps.)

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

JOB SHEET #3--CUT MILD STEEL AT A 90-DEGREE ANGLE, STOP, AND RESTART THE CUT

I. Equipment and materials

- A. Oxyacetylene cutting outfit with tip assembly
- B. Mild steel plate, approximately 1/4" x 4" x 8"
- C. Soapstone with a sharp point or edge
- D. Straightedge
- E. Welding gloves
- F. Welding goggles
- G. Pliers
- H. Coveralls or protective clothing free from oil and grease
- I. Flint lighter
- J. Welding or cutting table
- K. Slag box
- L. Can of water
- M. Cutting tip
- N. Foam or multipurpose dry-chemical fire extinguisher
- O. Tip cleaners

II. Procedure

- A. Make a 90-degree cut
  1. Mark four parallel lines 2 inches apart on plate to be cut
  2. Adjust oxygen regulator
  3. Adjust acetylene regulator
  4. Place plate to be cut over slag box
  5. Light torch with flint lighter

     (NOTE: Clean tips before lighting torch and as often as needed during cutting operation.)

JOB SHEET #3

6. Adjust to neutral flame

7. Place hoses behind you

8. Assume comfortable position

9. Maneuver torch as required

   (NOTE: Sometimes you must use both hands to hold torch steady for a straight cut.)

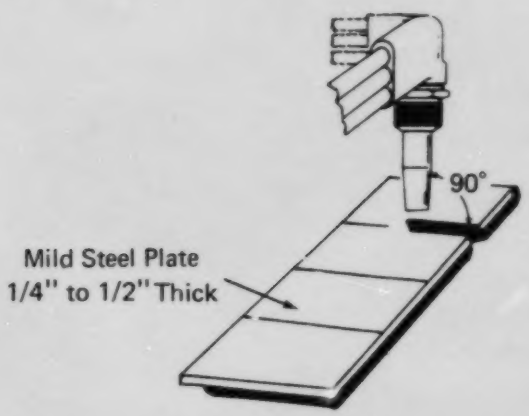
10. Hold preheat flame with tip of inner cone 1/16 inch to 1/8 inch above top of plate at right edge until red spot appears

    (CAUTION: Burning metal flames and sometimes sparks, creating the danger of burns.)

11. Depress the oxygen cutting lever and move from right to left across the plate (Figure 8)

    (NOTE: Left-handed operators move from left to right.)

FIGURE 8



12. Hold tip at right angle to work, while cutting with inner cone approximately 1/16 inch above work

13. Make 90-degree cuts until you have developed the proper procedure

14. Cool metal by placing in can of water with the aid of pliers

JOB SHEET #3

B. Restart a cut

1. Release oxygen cutting lever
2. Preheat only the edge where cutting action was stopped
3. Depress oxygen cutting lever slowly and continue cut

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

JOB SHEET #4--CUT ROUND STOCK

I. Equipment and materials

A. Oxyacetylene cutting outfit

B. Pieces of reinforcing bar, 1/2 inch, 5/8 inch, 3/4 inch, or 1 inch

C. Soapstone with sharp point or edge

D. Tape

E. Welding gloves

F. Welding goggles

G. Pliers

H. Coveralls or protective clothing free from oil and grease

I. Flint lighter

J. Welding or cutting table

K. Slag box

L. Can of water

M. Cutting tip

N. Foam or multipurpose dry-chemical fire extinguisher

O. Tip cleaners

II. Procedure

A. Mark reinforcing bar at desired length

B. Adjust oxygen and acetylene regulators

C. Place area to be cut over slag box

D. Light torch with flint lighter

(NOTE: Clean tip before lighting torch and as often as needed during welding operation.)

E. Adjust to neutral flame

JOB SHEET #4

F. Place hoses behind you

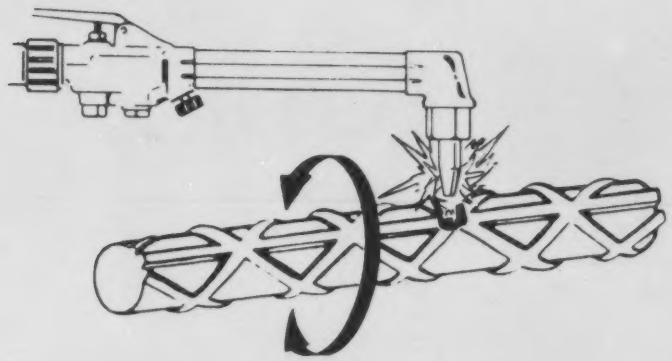
G. Assume comfortable position

H. Maneuver torch as required

I. Hold preheat flame with tip of inner cone 1/16 inch to 1/8 inch above edge of reinforcing bar until it becomes red

J. Depress cutting lever and rotate torch tip in direction of travel until rod is cut (Figure 9)

FIGURE 9



K. Hold tip at right angle to work, while cutting with inner cone approximately 1/16 inch above work

L. Cool metal by placing in can of water with the aid of pliers

M. Repeat procedure for each bar or rod

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

JOB SHEET #5--CUT CABLE

I. Equipment and materials

A. Oxyacetylene cutting outfit

B. Cutting tip

C. Flint lighter

D. Piece of cable

E. Soapstone with sharp point or edge

F. Welding goggles

G. Welding gloves

H. Can of water

I. Foam or multipurpose dry-chemical fire extinguisher

J. Coveralls or protective clothing free from oil and grease

K. Tip cleaners

II. Procedure

A. Place fire extinguisher near work area

B. Determine where cable is to be cut; mark with soapstone

C. Adjust oxygen and acetylene regulators

D. Light torch with flint lighter

(NOTE: Clean tip before lighting torch and as often as needed during welding operation.)

E. Adjust to neutral flame

F. Place hoses behind you

G. Assume comfortable position

H. Maneuver torch as required

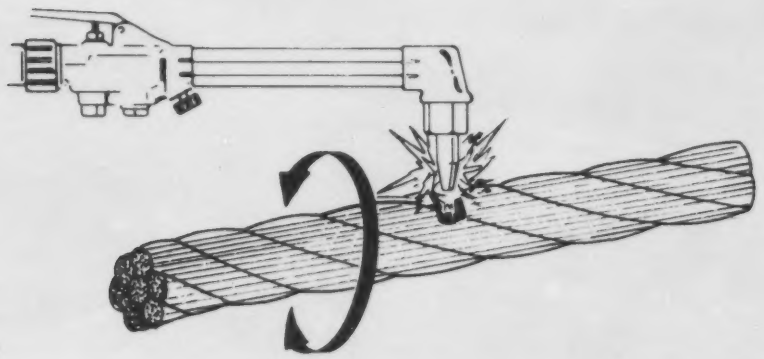
(CAUTION: If there is tension on the cable, take care to avoid flying loose ends when the cable is cut. These ends can be very dangerous.)

I. Hold preheat flame with tip of inner cone 1/16 inch to 1/8 inch above edge of cable until it becomes red

JOB SHEET #5

J. Depress cutting lever and rotate torch tip in direction of travel until cable is cut (Figure 10)

FIGURE 10



K. Hold tip at right angle to work, while cutting with inner cone approximately 1/16 inch above work

L. Cool metal by pouring water over hot ends

M. Repeat procedure for each cut

(NOTE: This is a very good method to use on all types of cables as it is quick and easy and will weld the ends, thus preventing raveling and reducing strain on the seizing.)

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

TEST

NAME_____ SCORE _____

1. Match terms associated with oxyacetylene cutting to their correct definitions. Write the correct numbers in the blanks.

_____a. Colorless, gaseous hydrocarbon used chiefly in cutting

_____b. Element that is normally a colorless, odorless, and tasteless gas; used in combination with other substances in cutting

_____c. Flame cutting of metal in which the preheating of the metal is accomplished with a flame produced by an oxyacetylene torch

_____d. To remove any foreign material from a system or component by flushing with the gas used in that system

_____e. Pounds per square inch

_____f. Capable of burning

_____g. Poisonous

_____h. That part of a shaft, axle, or spindle that turns in a bearing

_____i. Striker used to ignite torch

_____j. Metal container with a layer of water or sand to catch hot material

_____k. Metal that melts away during the oxyacetylene cutting process

_____l. Firmly binding cable with soft iron wire

1. Toxic
2. Purge
3. Oxygen
4. Combustible
5. Oxyacetylene cutting
6. psi
7. Acetylene
8. Seizing
9. Flint lighter
10. Journal
11. Slag box
12. Slag

2. State color codes for oxygen and acetylene.

a. Oxygen--_____

b. Acetylene--_____

TEST

3. Arrange in order stages in the oxygen-acetylene cutting process. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Mixture burns at several orifices in torch tip (preheat orifices)

_____b. Oxygen jet quickly oxidizes the heated base metal and blows it away

_____c. Separate, flexible hoses carry gases to torch

_____d. Flame heats base metal to a dull, cherry red

_____e. Pressure-regulated acetylene and pressure-regulated compressed oxygen are supplied from two cylinders

_____f. Removal of material leaves a cut in the metal

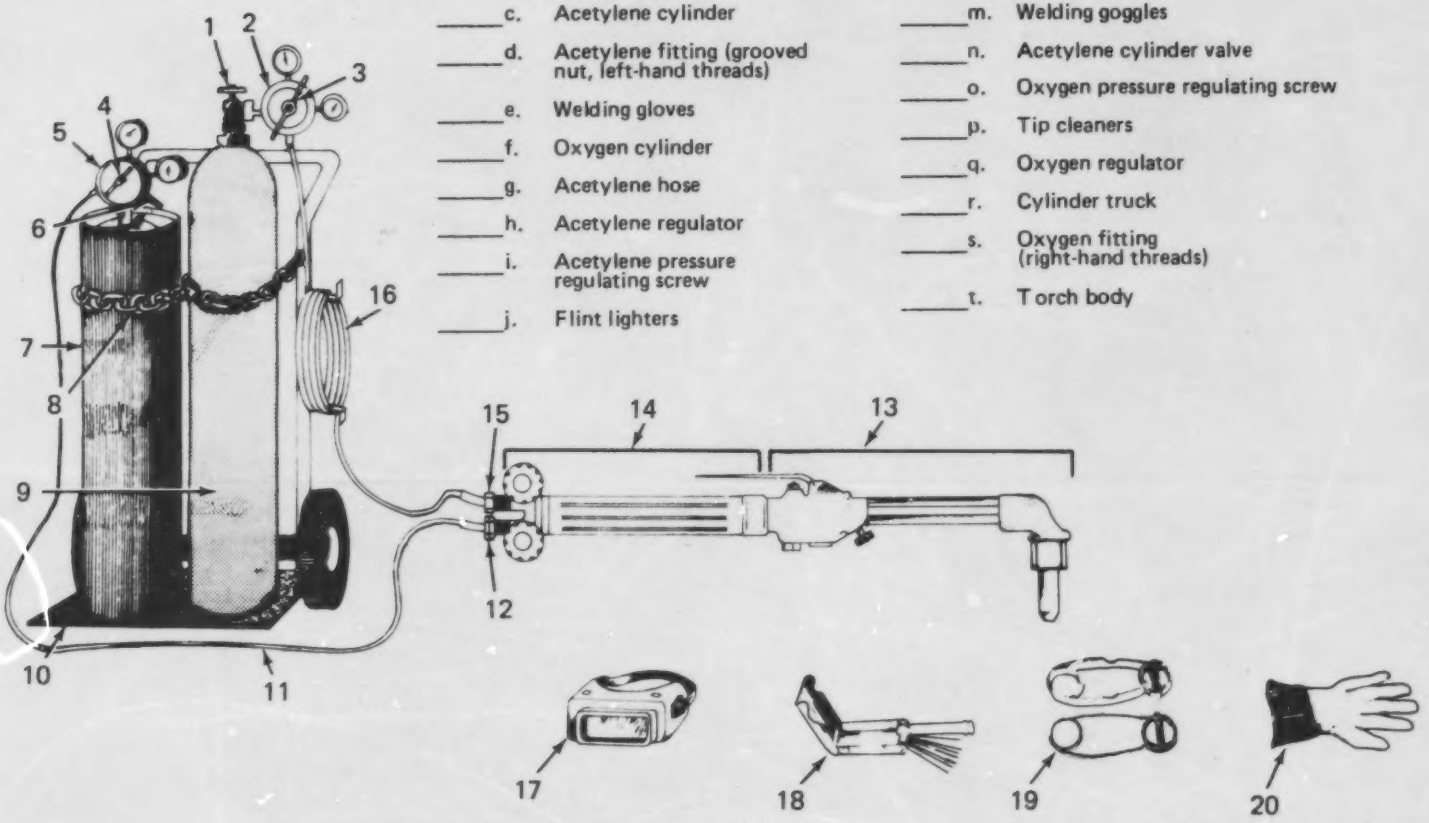
_____g. Operator ignites acetylene gas with spark from flint lighter

_____h. Operator presses oxygen lever, and jet of oxygen rushes out of cutting orifice

_____i. Operator opens oxygen torch valve, and gases are mixed inside torch

TEST

4. Identify the parts of an oxyacetylene cutting outfit. Write the correct numbers in the blanks.



_____a. Oxygen hose

_____b. Oxygen cylinder valve

_____c. Acetylene cylinder

_____d. Acetylene fitting (grooved nut, left-hand threads)

_____e. Welding gloves

_____f. Oxygen cylinder

_____g. Acetylene hose

_____h. Acetylene regulator

_____i. Acetylene pressure regulating screw

_____j. Flint lighters

_____k. Cutting attachment

_____l. Safety chain

_____m. Welding goggles

_____n. Acetylene cylinder valve

_____o. Oxygen pressure regulating screw

_____p. Tip cleaners

_____q. Oxygen regulator

_____r. Cylinder truck

_____s. Oxygen fitting (right-hand threads)

_____t. Torch body

TEST

5. Identify the parts of a torch body and cutting attachment. Write the correct numbers in the blanks.

_____a. Acetylene fitting (grooved nut, left-hand threads)

_____b. Cutting orifice

_____c. Oxygen fitting (right-hand threads)

_____d. Tip nut

_____e. Oxygen preheat valve

_____f. Preheat orifices

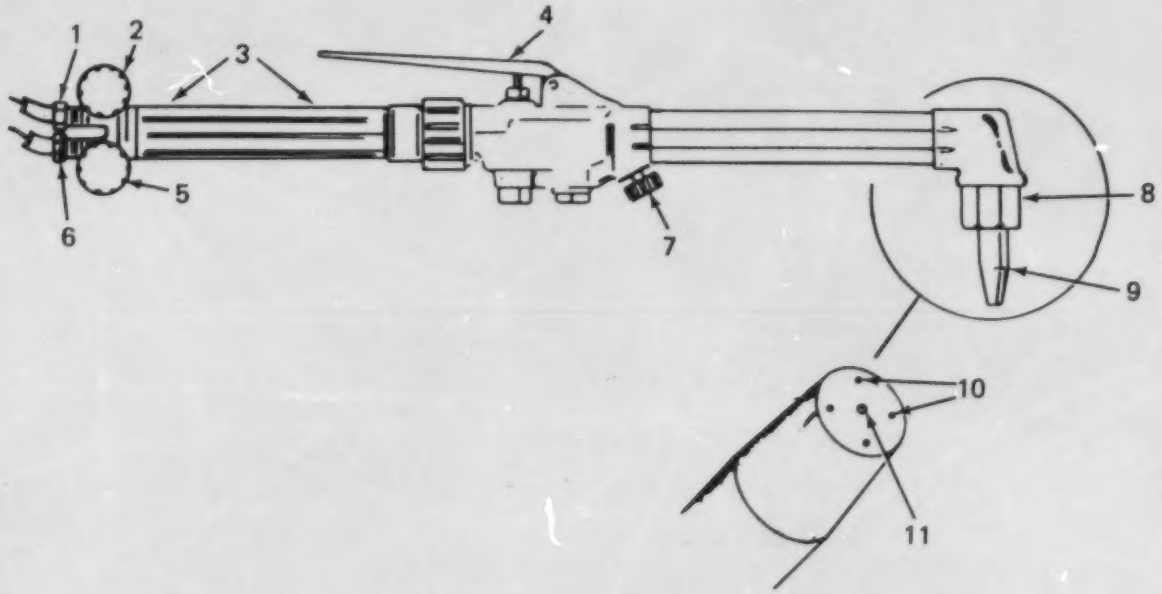
_____g. Oxygen torch valve

_____h. Tip

_____i. Oxygen cutting lever

_____j. Torch body

_____k. Acetylene torch valve



TEST

6. State twelve safety rules for working with oxygen and acetylene equipment.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

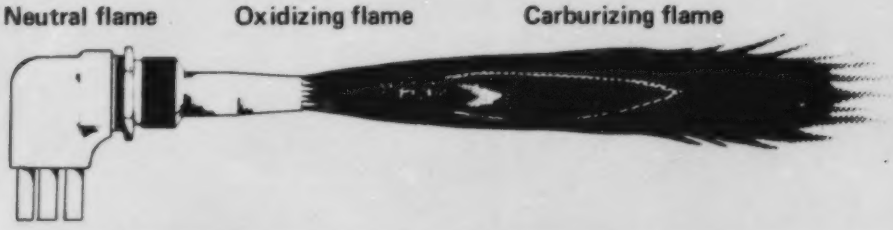
j. _____

k. _____

l. _____

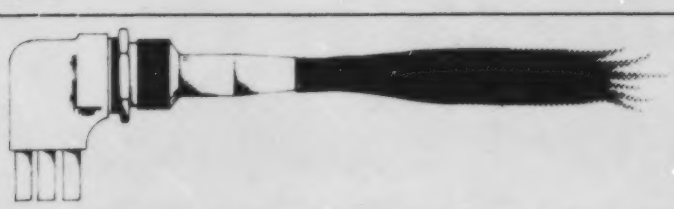
7. Identify the following types of oxyacetylene cutting flames. Write the correct names in the blanks.

Neutral flame **Oxidizing flame** **Carburizing flame**



a. _____

b. _____



c. _____

TEST

8. Arrange in order steps to follow in case of flashback. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Light torch

_____b. Release oxygen regulator screw

_____c. Reset regulator pressures

_____d. Close oxygen torch valve

_____e. Close oxygen preheat valve

_____f. Release acetylene regulator screw

_____g. Close acetylene torch valve

_____h. Examine acetylene unit

9. Select from the following list causes of backfire. Write an "X" in the blank before each correct answer.

_____a. Too much oxygen

_____b. Not enough acetylene or oxygen pressure for the tip size used

_____c. Too much acetylene

_____d. Loose cutting tip

_____e. Overheating of cutting tip

_____f. Bad O-ring in torch body

_____g. Dirty tip

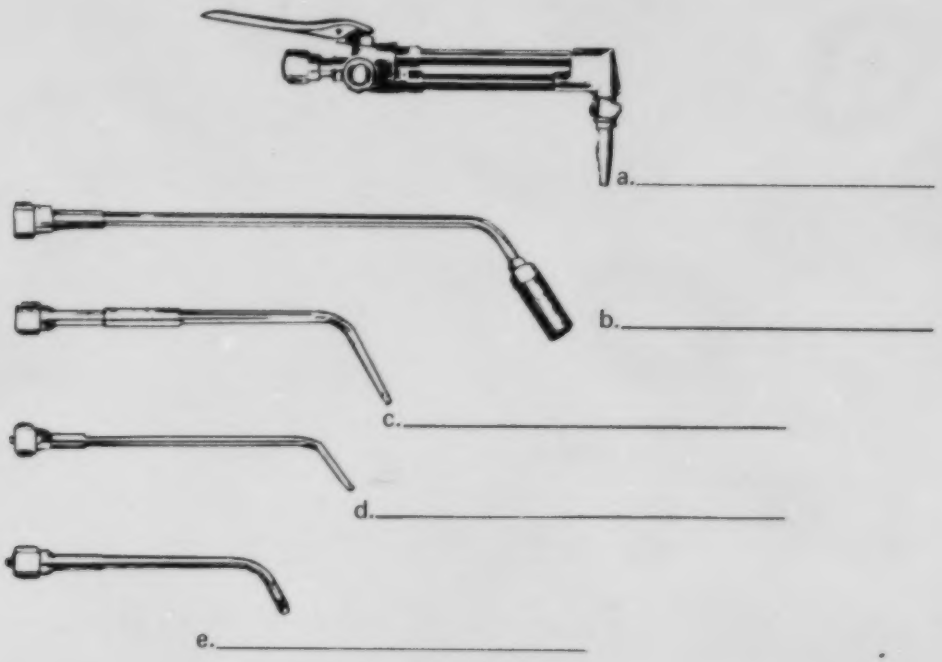
10. Distinguish between flashback and backfire. Write an "F" in the blank before flashback and a "B" in the blank before backfire.

_____a. Flame burns momentarily back into tip; then a loud snap or pop is emitted from the torch and the flame either goes out or continues to burn in a normal manner

_____b. Flame disappears inside torch body; at the same time, a squealing noise occurs and smoke and/or sparks are emitted from the torch tip

TEST

11. Identify a multiflame heating nozzle (rosebud) and tip from the illustrations below. Write an "X" in the blank beside the correct illustration.



12. Describe uses of a multiflame heating nozzle (rosebud)--_____

_____

_____

_____

(NOTE: Test question 13 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

13. Demonstrate the ability to

    a. Set up equipment for oxyacetylene cutting.

    b. Turn on, light, adjust to a neutral flame, and turn off oxyacetylene cutting equipment.

    c. Cut mild steel at a 90-degree angle, stop, and restart the cut.

    d. Cut round stock.

    e. Cut cable.

OXYACETYLENE CUTTING EQUIPMENT
UNIT I

ANSWERS TO TEST

1. a. 7
   b. 3
   c. 5
   d. 2
   e. 6
   f. 4
   g. 1
   h. 10
   i. 9
   j. 11
   k. 12
   l. 8

2. a. Green
   b. Red

3. a. 5
   b. 8
   c. 2
   d. 6
   e. 1
   f. 9
   g. 3
   h. 7
   i. 4

4. a. 16
   b. 1
   c. 7
   d. 12
   e. 20
   f. 9
   g. 11
   h. 5
   i. 4
   j. 19
   k. 13
   l. 8
   m. 17
   n. 6
   o. 3
   p. 18
   q. 2
   r. 10
   s. 15
   t. 14

5. a. 6
   b. 11
   c. 1
   d. 8
   e. 7
   f. 10
   g. 2
   h. 9
   i. 4
   j. 3
   k. 5

ANSWERS TO TEST

6. Answer should include any twelve of the following

   a. Make sure that either a foam or a multipurpose dry-chemical fire extinguisher is readily available and in working condition

   b. Wear welding goggles, gloves, and protective clothing

   c. Wear gloves to handle hot metal

   d. Use open torch only in a well-ventilated place

   e. Avoid breathing toxic fumes

   f. Do not leave a burning torch unattended

   g. Secure cylinders in a safe place

   h. Cut or weld at least 5 feet from cylinders

   i. Always use regulators; do not use oxygen or acetylene directly from cylinders

   j. Use flint lighters, *not matches,* for lighting torch

   k. Use hoses designated for oxygen and acetylene only

   l. Do not use oil on regulators, torches, fittings, or any equipment surface that may come in contact with oxygen

   m. Do not use compressed oxygen to clean off clothing

   n. Do not breathe compressed oxygen directly from cylinder or hose

   o. Use soap and paintbrush to test connections for leaks

   p. Do not use acetylene at pressures higher than 15 pounds per square inch

   q. Do not cut or weld directly on gravel or concrete

   r. Keep heat, flames, and sparks away from combustibles

   s. Do not cut or weld on containers that have been used to store combustible materials unless containers have been properly cleaned and purged

54

7. a. Carburizing flame

   b. Neutral flame

   c. Oxidizing flame

ANSWERS TO TEST

8. a. 8 e. 1
   b. 4 f. 5
   c. 7 g. 3
   d. 2 h. 6

9. b, d, e, f, g

10. a. B
    b. F

11. b

12. Description should include the following--Used to heat parts and/or metals, such as bearings, before fitting them to the journal; also used to preheat metal before welding

13. Performance skills evaluated to the satisfaction of the instructor

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to operate an air compressor and its attachments safely and effectively. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with air compressors and attachments to their correct definitions.
2. Arrange in order stages in the compression cycle.
3. Identify the parts of an air compressor.
4. Identify controls on a typical air compressor.
5. Match air compressor controls to their correct functions.
6. List safety rules for operating an air compressor.
7. Select from a list procedures for effective compressor operation.
8. Match compressor attachments to their correct uses.
9. List safety rules for operating compressor attachments.
10. Identify the parts of a rock drill.
11. Select from a list procedures for safe and effective rock drill operation.
12. Identify the parts of a paving breaker.
13. Match paving breaker tools to their correct uses.
14. Select from a list procedures for safe and effective paving breaker operation.
15. Identify the parts of a pneumatic vibrator.
16. Select from a list procedures for safe and effective vibrator operation.
17. Identify the parts of a tamper.
18. Select from a list procedures for safe and effective tamper operation.
19. Identify the parts of an impact wrench.

OBJECTIVE SHEET

20. Select from a list procedures for safe and effective impact wrench operation.

21. Match air compressor and attachments to their recommended safety equipment.

22. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on an air compressor.

    b. Service an air compressor.

    c. Start, warm up, operate, and shut down an air compressor.

    d. Operate a rock drill to drill a 2-inch hole in concrete or asphalt pavement.

    e. Operate a paving breaker to break a section of concrete.

    f. Operate a pneumatic vibrator to vibrate a concrete patch.

    g. Operate a pneumatic tamper to compact backfill around a box culvert.

    h. Operate an impact wrench to replace a guardrail.

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order materials to supplement unit.

1. Films

a. *Compressed Air Power.* Color, 17 minutes, 16 mm. Available from Compressed Air and Gas Institute, 1230 Keith Building, Cleveland, Ohio 44115, 216/241-7333.

(NOTE: This film explains in easy-to-understand terms the principles of compressed air power, the major types of compressors, the methods for operating air compressors, and the modern applications of the air compressor.)

b. *Bend Your Knees.* Color, 22 minutes, 16 mm or video-cassette, Portland Cement, 1977. Available from PCA, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077, 312/966-6200, ext. 450. Order number PC214.

(NOTE: This film shows how to lift properly to avoid back injuries.)

2. Publications

a. *Compressed Air and Gas Handbook,* 4th ed., 1973. Available from Compressed Air and Gas Institute, 1230 Keith Building, Cleveland, Ohio 44115, 216/241-7333.

b. *Compressed Air and Gas: An Introduction,* 1st ed., 1975. Available from Compressed Air and Gas Institute, 1230 Keith Building, Cleveland, Ohio 44115, 216/241-7333.

B. Make transparencies.

C. Provide students with objective sheet.

D. Provide students with information and job sheets.

E. Discuss unit and specific objectives.

F. Discuss information sheet.

G. Demonstrate and discuss procedures outlined in job sheets.

H. Provide alternate jobs if those in job sheets are not practical.

I. Arrange a field trip for students to observe operation of a compressor and its attachments.

SUGGESTED ACTIVITIES

J. Stress the need for relaxation and good balance when operating compressor attachments, and suggest ways to avoid muscle fatigue.

K. Review proper lifting techniques in *Highway Maintenance Equipment Operator: Basic Core,* Unit II, "Safety."

L. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM #1--Rock Drill Bit
2. TM #2--Paving Breaker Tools
3. TM #3--Paving Breaker Tools (Continued)

E. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on an Air Compressor
2. Job Sheet #2--Service an Air Compressor
3. Job Sheet #3--Start, Warm Up, Operate, and Shut Down an Air Compressor
4. Job Sheet #4--Operate a Rock Drill to Drill a 2-Inch Hole in Concrete or Asphalt Pavement
5. Job Sheet #5--Operate a Paving Breaker to Break a Section of Concrete
6. Job Sheet #6--Operate a Pneumatic Vibrator to Vibrate a Concrete Patch
7. Job Sheet #7--Operate a Pneumatic Tamper to Compact Backfill Around a Box Culvert
8. Job Sheet #8--Operate an Impact Wrench to Replace a Guardrail

F. Test

G. Answers to test

III. Unit references

A. *Compressed Air and Gas Handbook,* 4th ed. Cleveland, Ohio: Compressed Air and Gas Institute, 1973.

SUGGESTED ACTIVITIES

B. *Industrial Air Tools & Accessories.* St. Louis, Missouri: Chicago Pneumatic Air Tools, 1982.

C. *Instruction and Service Manual: Rota-Screw Portable Compressors.* Oklahoma City, Oklahoma: Gardner-Denver Company, n.d.

D. *Operating, Maintenance & Parts Manual, Model P-185A-W-JD.* Parsippany, New Jersey: Ingersoll-Rand Company, 1981.

E. *Operators Manual and Parts List: Sullair Portable Compressor.* Michigan City, Indiana: Sullair Corporation, 1980.

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

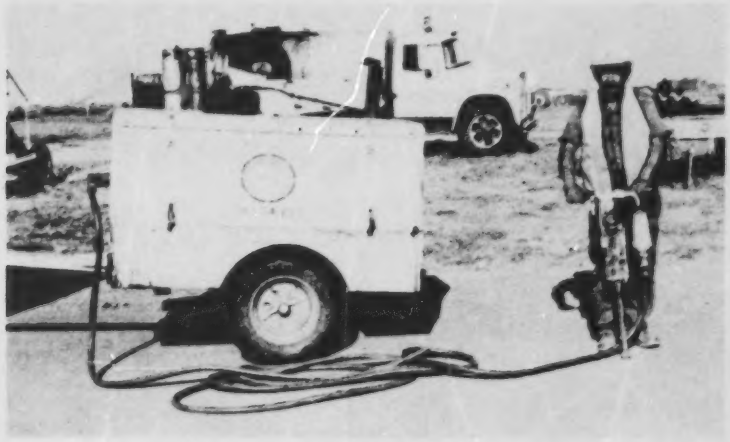
INFORMATION SHEET

I. Terms and definitions

A. Air compressor--Machine that increases the pressure of air by increasing its density; used to power a variety of attachments (Figure 1)

EXAMPLE:

FICURE 1



B. Attachments--Accessories that increase a machine's versatility and effectiveness

C. Pneumatic--Air powered

D. cfm--Cubic feet per minute

E. psi--Pounds per square inch

F. Moil--Round-ended tool for breaking pavement

G. Lift--Thickness of material spread in one layer

H. Repeated placement--Placement of concrete on top of concrete that has already been placed and vibrated

(NOTE: This procedure is repeated until the full depth is placed.)

I. Air line lubricator--Oil reservoir attached to air hose between compressor and attachment; keeps attachment lubricated during operation

J. Slab jacking--Leveling concrete slabs by drilling holes and pumping slurry mixture (mud) underneath

INFORMATION SHEET

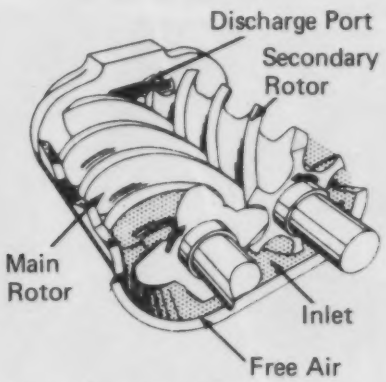
II. Stages in the compression cycle

(NOTE: There are many types of compressors: reciprocating [piston], diaphragm, impeller, rotary vane, and rotary screw. The following description is of a rotary screw compressor commonly used in highway maintenance.)

A. Rotors draw free air into compressor (Figure 2)

EXAMPLE:

FIGURE 2



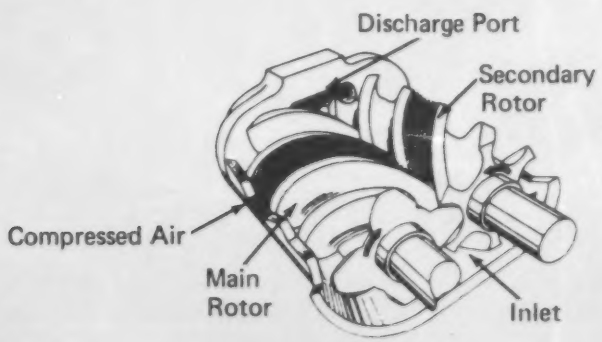
Used with permission of the Gardner-Denver Company.

B. Air inlet port closes, trapping air inside rotors

C. Rotors mesh and decrease air volume, thereby increasing pressure (Figure 3)

EXAMPLE:

FIGURE 3



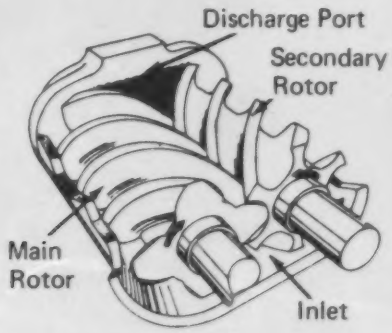
Used with permission of the Gardner-Denver Company.

INFORMATION SHEET

D. Compressed air moves toward discharge port (Figure 4)

EXAMPLE:

FIGURE 4



Used with permission of the Gardner-Denver Company.

E. Cooled lubricating oil is injected into compressed air

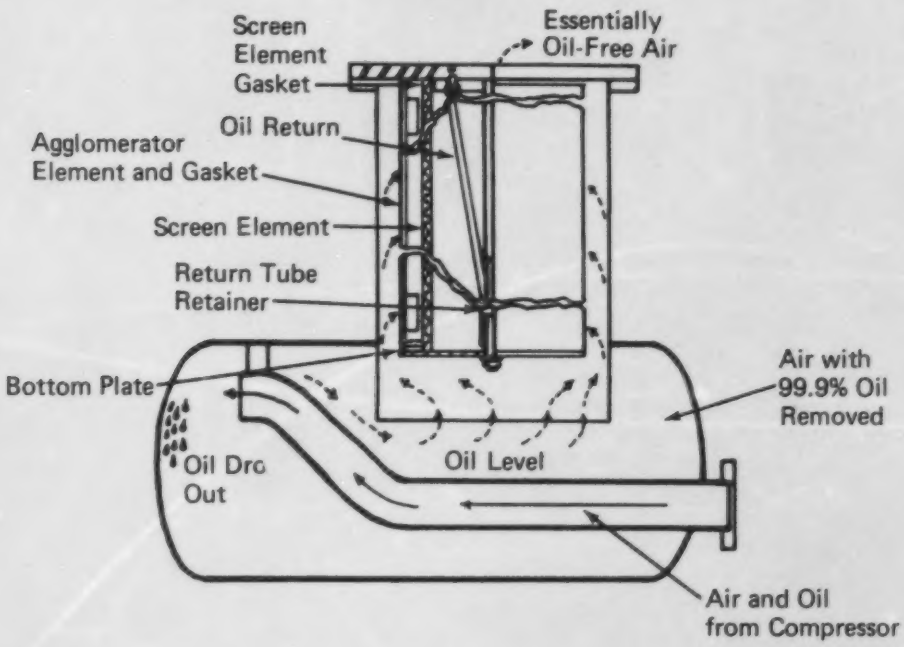
(NOTE: When cooled lubricating oil is injected, compression heat is removed and the temperature of the discharged air is lowered.)

INFORMATION SHEET

F. Oil and air mixture is directed into oil separator (receiver/separator system), which removes the oil (Figure 5)

EXAMPLE:

FIGURE 5

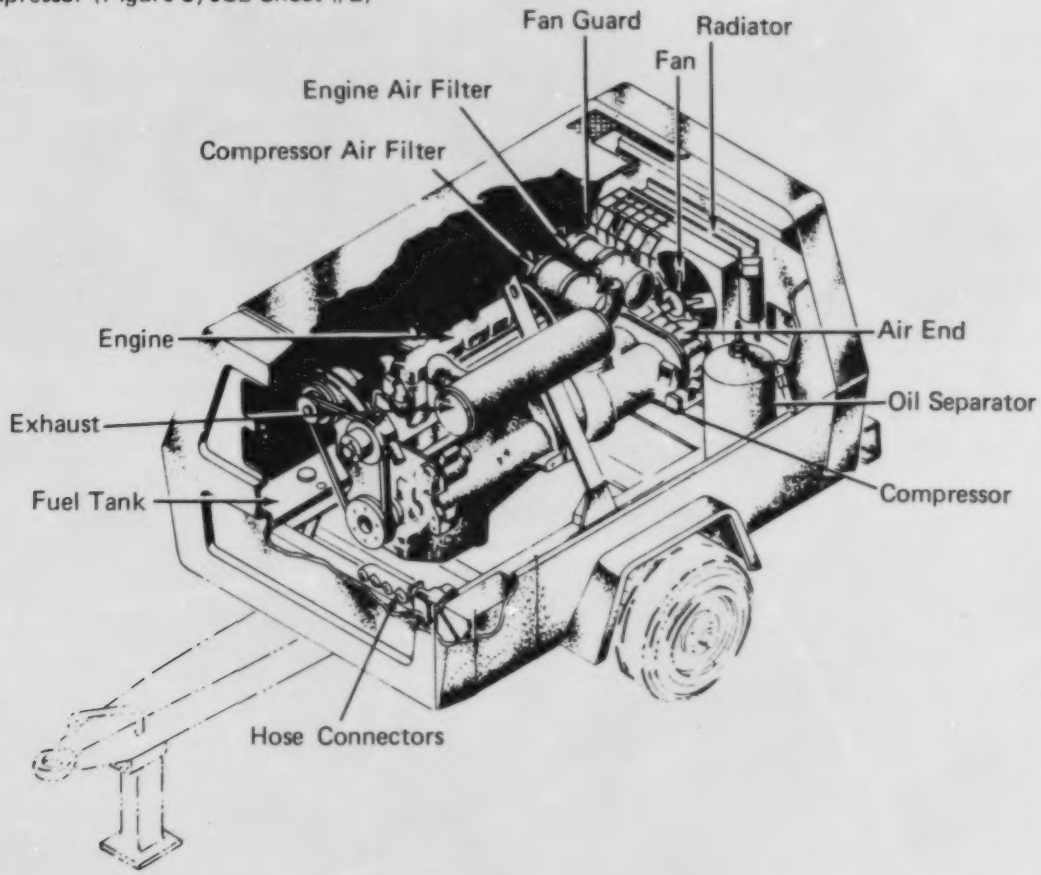


Used with permission of the Compressed Air and Gas Institute from *Compressed Air and Gas Handbook*, 4th ed.

G. Compressed air is discharged through hose connectors

III. Parts of an air compressor (Figure 6; Job Sheet #2)

FIGURE 6



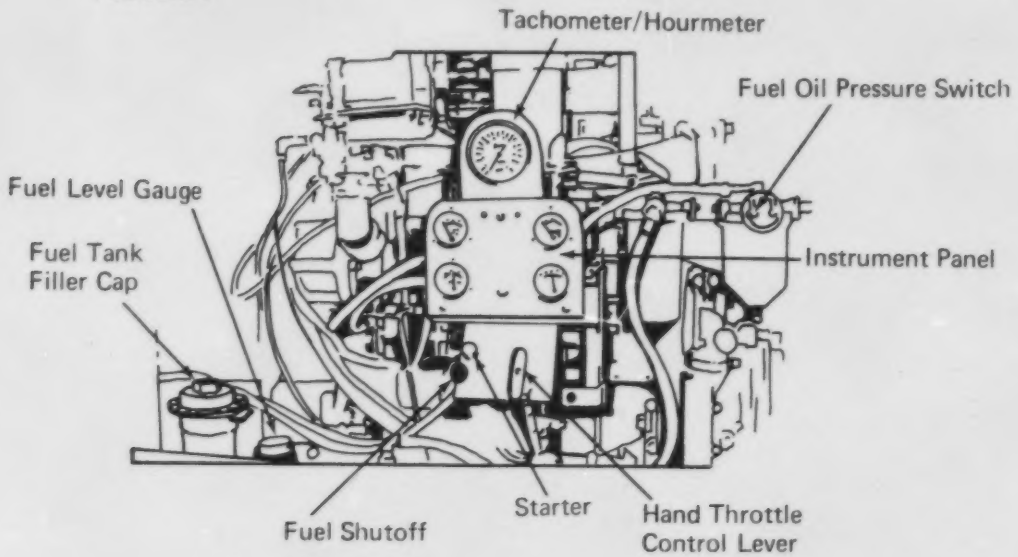
Used with permission of the Ingersoll-Rand Company.

INFORMATION SHEET

IV. Controls on a typical air compressor (Figures 7 and 8; Job Sheet #3)

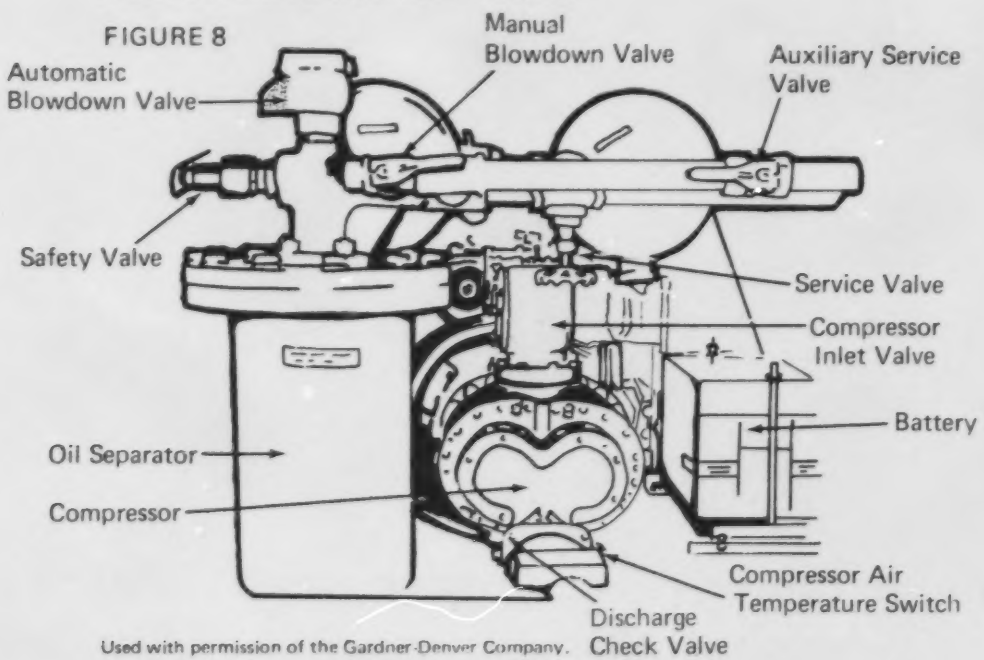
(NOTE: Controls and locations will vary with model and manufacturer.)

FIGURE 7



Used with permission of the Gardner-Denver Company.

FIGURE 8



Used with permission of the Gardner-Denver Company.

INFORMATION SHEET

V. Functions of air compressor controls (Job Sheet #3)

A. Tachometer--Registers engine rpm

B. Hourmeter--Registers hours of operation

C. Discharge pressure gauge--Indicates air pressure in receiver/separator system under various load and unload conditions

D. Engine water temperature gauge--Monitors temperature of engine water

E. Engine oil temperature gauge--Monitors temperature of engine oil

F. Oil level sight glass--Indicates oil level in oil separator

G. Starter--Cranks engine

(NOTE: When engine starts, starter should be released immediately.)

H. Pressure regulator--Regulates engine speed and air volume delivery

I. Service valve--Regulates amount of air passing through compressor system

J. Automatic blowdown valve--Releases compressed air from receiver/separator system when compressor is shut down

K. Manual blowdown valve--Allows receiver/separator system to be relieved of all pressure

L. Pressure relief valve (safety valve)--Vents separator pressure when inside pressure exceeds maximum operating pressure

M. Hand throttle control lever--Sets engine speed

N. Discharge check valve--Cuts off reverse flow of air/oil mixture through compressor discharge system when compressor is shut down

VI. Safety rules for operating an air compressor

(NOTE: The compressor discharges hot exhaust, and the unit will heat up with use. Use common sense; avoid burns.)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear close-fitting clothing; keep long hair tied back

D. Keep hands, arms, and clothing away from belts, pulleys, and other moving parts

E. Be sure that all guards and shields are in good working order and in place at all times

INFORMATION SHEET

F. Make sure that all personnel are clear of compressor before starting or operating it

G. Make adjustments only when engine is shut off

H. Keep away from all points of air discharge and away from hot exhaust gases

(NOTE: Do not use compressed air to clean clothing.)

I. Be sure that all connections and couplings are *completely* interlocked and pinned

J. Set up compressor in a location that is as level as possible

K. Block wheels

L. Do not smoke when fueling compressor

M. Make sure that all warning and safety devices are working properly

N. Use extra caution when injecting ether or other cold-weather starting aids

O. Do not exceed recommended maximum air pressure

P. Be sure that *all pressure* has been released before disconnecting hoses

(CAUTION: Use caution when releasing pressure from compressor air chamber.)

Q. Keep compressor clean

VII. Procedures for effective compressor operation (Job Sheet #1)

A. Perform all prestart inspection and maintenance procedures

B. Close service valves and manual blowdown valve when starting compressor

C. Operate at full throttle under most circumstances

D. Operate with side doors open unless manufacturer recommends otherwise

E. Keep unit as level as possible

(NOTE: An unlevel unit may give a false coolant level reading.)

F. Check gauges often during operation

G. Check air cleaner often when operating in dusty conditions

INFORMATION SHEET

VIII. Compressor attachments and their uses

A. Rock drill (jackhammer)--Used to drill holes in concrete (see Figure 9; Job Sheet #4)

B. Paving breaker--Used to break up concrete, boulders (to be used as fill), asphalt mats, and hard earth; also used for cutting lines to repair potholes (see Figure 12; Job Sheet #5)

(NOTE: The paving breaker can be fitted with a number of accessory tools for different jobs. See Figure 12.)

C. Vibrator--Used to remove air bubbles in concrete to settle the concrete close against forms and reinforcing steel (see Figure 13; Job Sheet #6)

D. Tamper--Used to compact material (see Figure 14; Job Sheet #7)

E. Impact wrench--Used to loosen or tighten bolts (see Figure 15; Job Sheet #8)

EXAMPLES: On equipment, signs, guardrails

F. Saw--Used to cut bridge timbers, even tops of guard posts, and clear brush

IX. Safety rules for operating compressor attachments

(NOTE: Back injuries, foot injuries, and fatigue are common when working with pneumatic tools. The best defenses against these injuries are alertness and relaxation.)

A. Study departmental safety manual for each tool

B. Wear protective devices for attachment tool you are using

EXAMPLES: Close-fitting clothing, hard-toed shoes, ear protection

C. Operate from a well-balanced, comfortable position

(NOTE: Avoid cramped or awkward positions.)

D. Work relaxed

E. Keep hands and feet away from moving parts as much as possible

F. Use correct lifting techniques

G. Check all connections before operating attachment tools

(CAUTION: If coupling releases, the hose will wrap around the operator's body like a snake. The hose can break skin, teeth, and bones.)

H. Be sure that chucks and retainers are tight and are holding shank securely

INFORMATION SHEET

I. Position yourself so that initial burst of air will not hit you

J. Keep feet away from hose

K. Keep hose away from working attachment tool

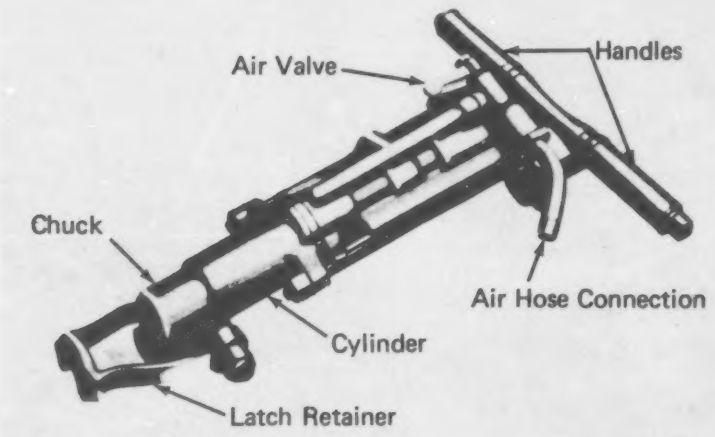
L. Before disconnecting hose from attachment, shut off air compressor, and then release pressure from attachment

(CAUTION: Disconnect hose at attachment end before disconnecting compressor end.)

X. Parts of a rock drill (Figure 9; Transparency #1)

(NOTE: Rock drill tools fit into the chuck and rotate. The drill is also moved up and down by piston action.)

FIGURE 9



Courtesy of American Pneumatic Tool Company.

XI. Procedures for safe and effective rock drill operation (Job Sheet #4)

(NOTE: Hold air valve up for off, down for drilling, and half up for blowing.)

A. Be sure that shank and bit are tightly secured

INFORMATION SHEET

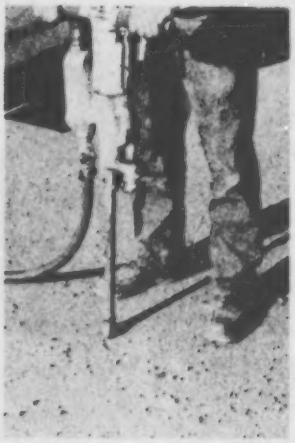
B. Place drill between feet to start drilling (Figures 10 and 11)

(NOTE: This position prevents the drill from jumping up and hitting your foot. As soon as drill is turning enough to bear down, pull your feet back.)

EXAMPLES:

FIGURE 10

FIGURE 11



C. Keep drill straight when drilling straight down

D. Use extra caution when drilling at an angle

E. Use a firm grip and apply just enough downward pressure to keep drill from bouncing

(CAUTION: Do not push or force drill.)

F. Blow out hole frequently during drilling

G. Leave drill standing in hole while you shut off compressor

H. Check oil level in lubricator often

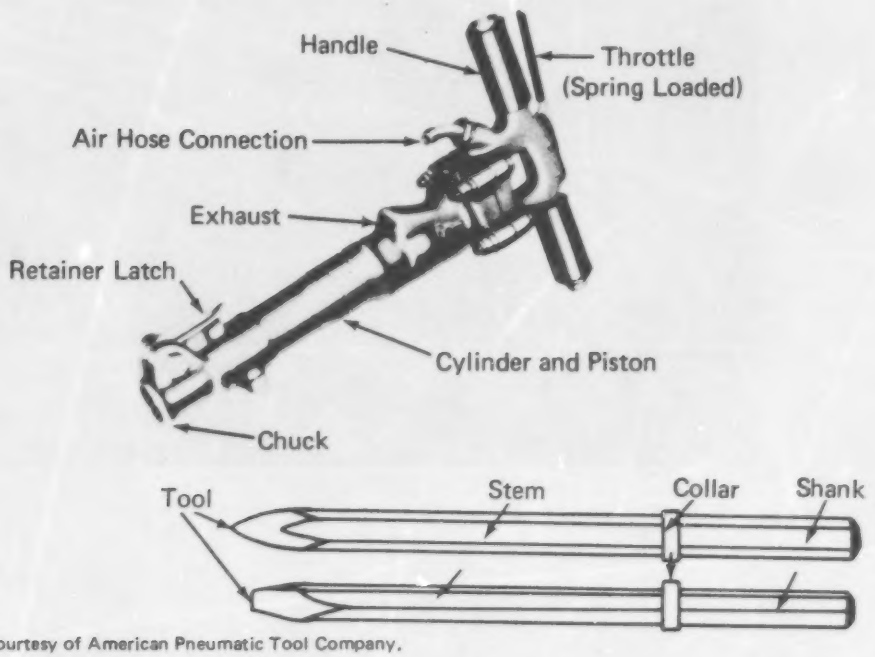
I. Check tightness of all bolts, nuts, and fittings several times a day

INFORMATION SHEET

XII. Parts of a paving breaker (Figure 12)

(NOTE: Paving breaker tools are inserted into the chuck and moved up and down by piston action.)

FIGURE 12



Courtesy of American Pneumatic Tool Company.

XIII. Paving breaker tools and uses (Transparencies #2 and #3)

A. Moil-point tool--Used for breaking hard materials such as concrete, asphalt, and rock

B. Spear- or narrow-point chisel--Used for shaping and finishing edges on concrete, slate, and other materials

C. Standard 3-inch chisel--Used for breaking up concrete

D. Digging chisel--Used for cutting narrow, deep ditches

E. Clay spade--Used for digging footings and ditches in soft soils, and for shaping sides of ditches

F. Asphalt cutter--Used for cutting a straight line in asphalt

G. Asphalt wedge--Used for lifting cut asphalt

H. Square and round dirt tampers--Used for compacting soil

INFORMATION SHEET

XIV. Procedures for safe and effective paving breaker operation (Job Sheet #5)

A. Keep hose away from you

B. Set breaker in position to cut or break before turning on power

C. Begin breaking concrete at corners

D. Begin removing asphalt on one end, and work from side to side between cuts

E. Bear down at an angle to break asphalt loose

(NOTE: Back up and pull handle toward you, using breaker as a pry bar.)

F. Check tightness of all bolts, nuts, and fittings daily

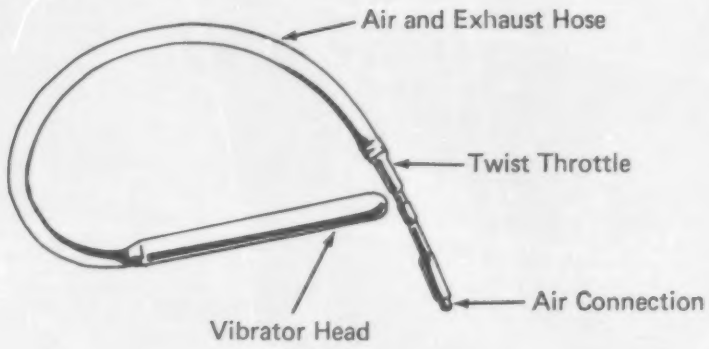
G. Check oil level in lubricator often

H. Keep feet clear of attachment tool

XV. Parts of a pneumatic vibrator (Figure 13)

(NOTE: A pneumatic vibrator is a vibrating head attached to a hose. The hose and head are inserted into freshly poured concrete, where the head breaks up air bubbles in the concrete.)

FIGURE 13



XVI. Procedures for safe and effective vibrator operation (Job Sheet #6)

A. Insert vibrator to full depth of newly poured concrete

(NOTE: On repeated placements, insert the vibrator only until there is a little slack in the hose.)

B. Retract vibrator slowly

(NOTE: Retract only to the top of the last placement on repeated placements.)

C. Pull vibrator out overhand

D. Lift vibrator straight out, close to the body

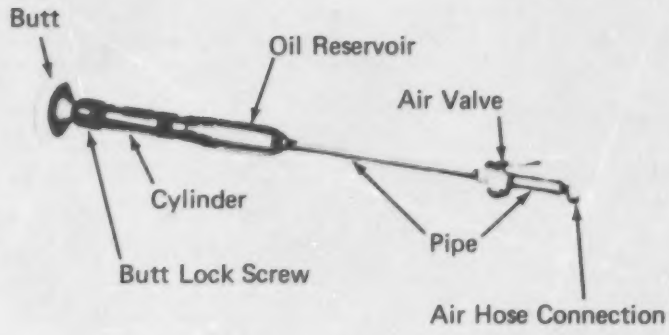
(CAUTION: Be careful not to lose your balance as you retract the vibrator.)

E. Keep toes and feet clear

XVII. Parts of a tamper (Figure 14)

(NOTE: The tamper vibrates and compacts soil or other materials.)

FIGURE 14



Courtesy of American Pneumatic Tool Company.

XVIII. Procedures for safe and effective tamper operation (Job Sheet #7)

A. Wear insulated gloves

(NOTE: Tamper pipe will get hot.)

INFORMATION SHEET

B. Keep feet clear of tamper

C. Tamp from side to side

D. Work back and forth across the shortest distance

E. Guide machine; do not force

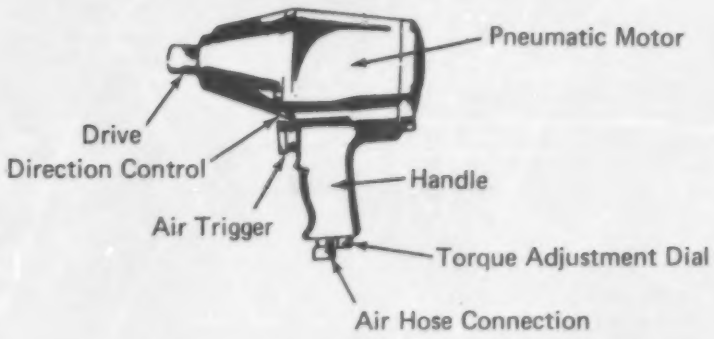
F. Work a small section; then move tamper to overlap that section

G. Tamp each section until the desired compaction is reached

XIX. Parts of an impact wrench (Figure 15)

(NOTE: An impact wrench has special impact sockets that fit into the drive and turn clockwise or counterclockwise.)

FIGURE 15



XX. Procedures for safe and effective impact wrench operation (Job Sheet #8)

A. Do not wear gloves

(NOTE: If wrench is too hot to hold with bare hands, gloves may be necessary, but *remove them when seating wrench or bolt*.)

B. Be sure wrench is well seated on bolt before turning on power

C. Before operating, set torque to desired tension

D. Take care not to pinch your fingers when putting drive on bolt

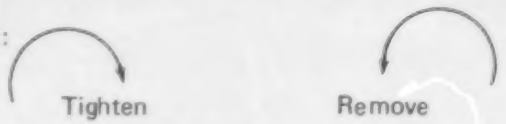
INFORMATION SHEET

E. Set wrench to turn clockwise to tighten bolts or counterclockwise to loosen bolts (Figure 16)

(NOTE: Some bolts have left-handed threads and would, therefore, be turned in the opposite direction.)

EXAMPLE:

FIGURE 16



F. Tighten bolts until correct torque is reached

(NOTE: Correct torque is reached when socket no longer turns. Wrench will make a different sound when the bolt is tightened to the correct torque.)

XXI. Recommended safety equipment for air compressor and attachments

(NOTE: Wear a respirator in extremely dusty conditions.)

A. Hard hat--Compressor and all attachments

B. Hard-toed shoes--Compressor and all attachments

C. Ear protection--Compressor and all attachments

D. Close-fitting clothing--Compressor and all attachments

E. Gloves--Compressor, rock drill, paving breaker, tamper

(NOTE: Parts of the attachment will heat up with use. Use gloves to protect hands from burns.)

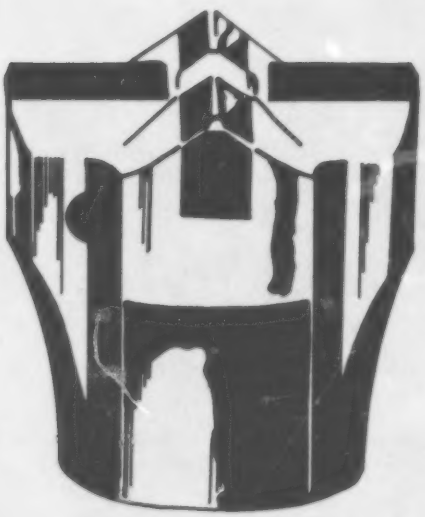
(CAUTION: Do not wear gloves to operate impact wrench. If wrench gets hot, wear gloves, but remove them when seating wrench on bolt.)

F. Goggles--Compressor, rock drill, paving breaker

Rock Drill Bit

Drill Steel

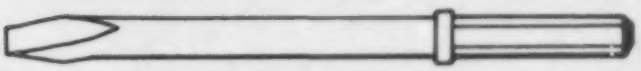
Bit (Sizes 15/16" to 2 1/2")



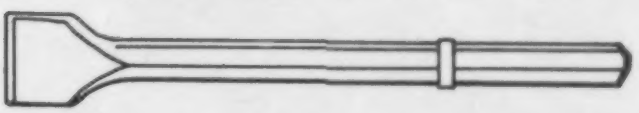
Paving Breaker Tools

Moil-Point Tool

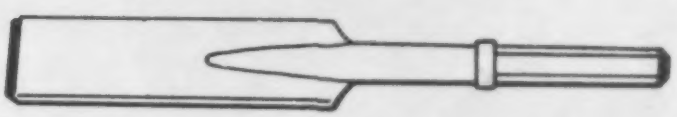
Spear- or Narrow-Point Chisel



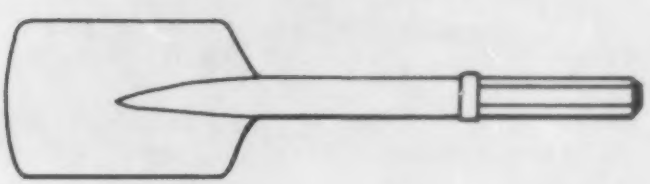
Standard 3-Inch Chisel



Digging Chisel



Clay Spade



Paving Breaker Tools
(Continued)

Asphalt Cutter

Asphalt Wedge

Dirt Tampers--Round and Square

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

JOB SHEET #1--PERFORM PRESTART INSPECTION
AND MAINTENANCE PROCEDURES ON AN AIR COMPRESSOR

I. Equipment and materials

A. Air compressor

B. Operator's manual

C. Engine oil

D. Engine coolant

E. Compressor lubricant

(NOTE: See operator's manual. Do not substitute or mix lubricants.)

F. Fuel

G. Grease

H. Grease gun

I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level; add engine oil if needed

C. Check coolant level; add fluid if needed

D. Check compressor lubricating oil; add oil if needed

(NOTE: *Do not overfill.* Check operator's manual for gauge level.)

E. Check fuel level; fill tank if necessary

F. Check battery connections for tightness and corrosion

G. Check battery electrolyte level; add water if needed

H. Check air cleaner; remove and clean filter if necessary

I. Clean all grease fittings and lubricate according to operator's manual

JOB SHEET #1

J. Check drive belts for tightness

K. Check electrical wire connections and insulation

L. Check gauges

M. Check lights

N. Check safety devices

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

JOB SHEET #2--SERVICE AN AIR COMPRESSOR

I. Equipment and materials

A. Air compressor

B. Operator's manual

C. Tool kit

D. Air supply

E. Lubricants

F. Cleaning solvents

G. Rags

H. Water

I. Engine coolant

J. Engine oil

K. Transmission fluid

L. Fuel

M. Tire pressure gauge

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

C. Check engine coolant level, radiator cap, hoses, and radiator; add coolant if needed; clean grill

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

JOB SHEET #2

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check transmission fluid level; add fluid if needed

I. Check transmission pressure line filter and breather if machine is so equipped

J. Check drive belts for tension and wear; adjust or replace if necessary

K. Check wiring, insulation, and connections

L. Clean and lubricate all grease fittings according to operator's manual

M. Check condition of tires

N. Check tire pressure; inflate to recommended pressure if necessary

O. Check all safety devices; repair if necessary

P. Check safety shutdown system

Q. Check hoses and couplings

R. Check attachments; service according to operator's manual

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

JOB SHEET #3--START, WARM UP, OPERATE, AND SHUT DOWN AN AIR COMPRESSOR

I. Equipment and materials

A. Air compressor

B. Operator's manual

C. Attachment, such as tamper or paving breaker, for practice

D. 50 feet of 3/4-inch high-pressure air hose with quick couplers

E. Recommended safety equipment

1. Hard hat
2. Close-fitting clothing
3. Hard-toed shoes
4. Gloves
5. Goggles
6. Earplugs

II. Procedure

A. Read operator's manual for procedures and controls

B. Perform all prestart inspection and maintenance procedures

C. Place compressor in a level position

(NOTE: An unlevel unit may give a false coolant level reading.)

D. Open sides so that gauges and controls are accessible and air can circulate

(CAUTION: Always ventilate unit before operating.)

E. Open manual blowdown valve to relieve any pressure left in system

F. Close valve after relieving system

G. Close all service valves

(NOTE: In order to build up full air pressure and ensure proper oil circulation, all service valves must be closed before starting the unit.)

H. Turn ON/OFF switch to the ON position

JOB SHEET #3

I. Activate bypass system, if machine is so equipped, according to operator's manual

J. Activate starter; release as soon as engine starts

(CAUTION: Do not crank engine for more than twenty seconds. Allow engine to cool for at least two minutes before attempting to start the engine again.)

K. Shut off bypass switch if machine is so equipped

L. Allow water temperature and air pressure to build to manufacturer's recommended levels

M. Connect air hose to compressor and to attachment

N. Check couplings to be sure they are secure

O. Check gauges for temperature pressure levels

P. Open service valve on compressor

Q. Walk slowly and carefully around compressor, at a distance of about 6 feet, to locate exhaust and high-temperature areas

(NOTE: Once you have located these areas, stay clear of them.)

R. Note where hose is attached to attachment, and keep connection in direct line with compressor

(NOTE: Do not let hose wrap around your body.)

S. Practice moving attachment, keeping hose away from your feet and away from the working end of the attachment tool

(NOTE: Use proper lifting techniques.)

T. Set attachment in position and open air valve

U. Operate attachment with body as relaxed as possible, keeping a firm grip and firm footing

V. Practice guiding attachment and gaining control

(NOTE: Remind yourself to relax. *Do not overwork muscles*.)

W. Close air valve on attachment

X. Close all service valves on compressor

JOB SHEET #3

Y. Allow compressor to idle for three to five minutes before shutting engine off

(NOTE: This procedure permits the engine to cool down and allows for gradual and uniform cooling of engine parts.)

Z. Turn ON/OFF switch to OFF position

(NOTE: If compressor is equipped with an automatic blowdown valve, the valve should relieve all pressure from the compressor. Stay clear of outlets.)

AA. Open relief valve on compressor to relieve pressure

BB. Open air valve on attachment to relieve pressure in hose

CC. Remove hose from attachment

DD. Remove hose from compressor

EE. Store hose, attachment, and tool(s) in designated places

FF. Close side doors and secure compressor

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

JOB SHEET #4--OPERATE A ROCK DRILL TO DRILL A 2-INCH HOLE IN CONCRETE OR ASPHALT PAVEMENT

I. Equipment and materials

A. Compressor, 125 cfm (minimum)

B. Operator's manual

C. Rock drill with drill steel and 2-inch bits

D. 50 feet of 3/4-inch high-pressure air hose

E. Recommended safety equipment

1. Hard hat
2. Close-fitting clothing
3. Hard-toed shoes
4. Gloves
5. Goggles
6. Respirator
7. Earplugs

II. Procedure

A. Perform all prestart inspection and maintenance procedures

B. Start and warm up compressor

C. Check level of oil in lubricator; add oil if needed

D. Attach air hose to compressor and to rock drill

E. Screw 2-inch drill bit onto drill steel

(NOTE: Drill steel should be 18 to 24 inches long for drilling into or through 4 to 8 inches of pavement.)

F. Swing drill steel retaining latch to one side

G. Insert shank into chuck

H. Lock the retaining latch below collar on shank

JOB SHEET #4

I. Open service valve on compressor

J. Grasp handles of rock drill and lift it to a vertical position

K. Center bit over location where hole is to be drilled

(NOTE: Use proper lifting techniques.)

L. Position drill bit between feet

(NOTE: This allows drill to rotate and keeps it in place.)

(CAUTION: Drill may jump.)

M. Open air valve just enough to start the drill steel rotating and impacting

N. Remove feet as bit bores downward

O. Gradually open air valve to full capacity

P. Drill to a depth of approximately 2 inches

(NOTE: Hold drill straight; do not drill at an angle.)

Q. Move air valve to just above center

(NOTE: This will force air through the drill steel and the bit to the bottom of the hole, blowing out dust and debris.)

R. Open air valve to full capacity

S. Repeat steps M through O until the desired depth is reached

T. Close rock drill air valve

U. Shut down compressor

V. Open relief valve on compressor to exhaust compressed air

W. Open air valve on rock drill to relieve pressure in hose

X. Disconnect hose from drill

Y. Disconnect hose from compressor

Z. Store drill and hose in proper places

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

JOB SHEET #5--OPERATE A PAVING BREAKER TO BREAK A SECTION OF CONCRETE

I. Equipment and materials

- A. Compressor, 125 cfm (minimum)
- B. Operator's manual
- C. Paving breaker
- D. Moil-point tool
- E. 50 feet of 3/4-inch high-pressure air hose with quick couplers
- F. Correct oil type
- G. Recommended safety equipment
  1. Hard hat
  2. Close-fitting clothing
  3. Hard-toed shoes
  4. Gloves
  5. Goggles
  6. Respirator
  7. Earplugs

II. Procedure

- A. Perform all prestart inspection and maintenance procedures
- B. Check oil level in paving breaker oil reservoir; fill if low
- C. Start and warm up compressor
- D. Attach air hose to compressor and paving breaker
- E. Pull latch retainer lever down
- F. Insert moil shank into paving breaker chuck
- G. Push latch retainer lever to UP position
- H. Open service valve at compressor
- I. Grip handles firmly and raise paving breaker to a vertical position

  (NOTE: Use proper lifting techniques.)

JOB SHEET #5

J. Position moil about 6 inches from one corner of pavement section

K. Press down on throttle to start impact action

(NOTE: The throttle is located on the top of one of the handles. It is spring loaded and will close the air valve when released.)

L. Move drill back and forth slightly to be sure that bit does not bind

(NOTE: If bit gets wedged or starts to bind, remove drill and start another hole.)

M. Continue with impact action until corner is broken the full depth of the concrete

N. Release air valve and raise breaker

O. Reposition moil about 6 inches to right or left of broken corner; repeat procedure

(NOTE: The 6-inch distance may vary with the thickness or the strength of the concrete. If the concrete is to be broken into large sections, the procedure will change.)

P. Continue impacting until entire section is broken into pieces of the size desired

Q. Release air valve; lay breaker down carefully

R. Shut down compressor

S. Open relief valve on compressor to relieve pressure

T. Open air valve on breaker to relieve pressure in hose

U. Disconnect air hose from breaker

V. Disconnect air hose from compressor

W. Store breaker, tool, and hoses in proper places

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

JOB SHEET #6--OPERATE A PNEUMATIC VIBRATOR TO VIBRATE A CONCRETE PATCH

I. Equipment, materials, and personnel

- A. Compressor, 125 cfm (minimum)
- B. Operator's manual
- C. Vibrator head with hose attached
- D. 50 feet of 3/4-inch high-pressure air hose with quick couplers
- E. Water supply and hose
- F. Recommended safety equipment
  1. Hard hat
  2. Close-fitting clothing
  3. Hard-toed shoes
  4. Gloves
  5. Goggles
  6. Earplugs
- G. Forms
- H. Concrete
- I. Concrete pouring crew

II. Procedure

- A. Perform prestart inspection and maintenance procedures
- B. Check lubricant level; add lubricant if needed
- C. Start and warm up compressor
- D. Attach air hose to compressor and to vibrator
- E. Open service valve at compressor
- F. Lower vibrator into newly poured concrete
- G. Open air valve at vibrator, and start vibrating action

  (NOTE: Be sure to vibrate enough to fill all voids against the forms.)
- H. Slowly raise vibrator to surface

JOB SHEET #6

I. Continue vibrating and raising vibrator head as concrete is placed until form is filled to desired height

J. Lift vibrator out of concrete

(NOTE: Pull overhand and straight out, keeping the hose and vibrator close to your body. Be careful not to lose your balance.)

K. Close the air valve to vibrator

L. Carefully lower vibrator to ground

M. Close service valve at compressor

N. Shut down compressor

O. Open relief valve on compressor to relieve pressure

P. Open air valve on vibrator to relieve pressure in hose

Q. Disconnect air hose from vibrator

R. Disconnect air hose from compressor

S. Wash down vibrator head and hose with water

(NOTE: Be sure that all concrete is cleaned from vibrator and hose.)

T. Store vibrator and hose in proper places

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

JOB SHEET #7--OPERATE A PNEUMATIC TAMPER TO COMPACT BACKFILL AROUND A BOX CULVERT

I. Equipment, materials, and personnel

A. Compressor, 125 cfm (minimum)

B. Operator's manual

C. Tamper

D. 50 feet of 3/4-inch high-pressure air hose with quick couplers

E. Recommended safety equipment

1. Hard hat
2. Close-fitting clothing
3. Hard-toed shoes
4. Gloves
5. Goggles
6. Earplugs

F. Backfill material and maintenance crew

II. Procedure

A. Perform prestart inspection and maintenance procedures

B. Check oil level in tamper reservoir; fill if low

C. Start and warm up compressor

D. Attach air hose to compressor and to tamper

E. Open service valve on compressor

F. Raise tamper to a vertical position

G. Position tamper at starting point

H. Squeeze air throttle to open valve and start tamping action

(NOTE: Hold throttle down during operation. The throttle is spring loaded and will close the air valve if released.)

I. Continue tamping the first lift from one end of the culvert to the other until desired compaction is accomplished

JOB SHEET #7

J. After next lift of backfill is placed, repeat steps G through I

K. Continue tamping after each lift of backfill is placed until job is completed

L. Shut down compressor

M. Open relief valve on compressor to relieve pressure

N. Open air valve on tamper to relieve pressure in hose

O. Disconnect air hose from tamper

P. Disconnect air hose from compressor

Q. Store hose and tamper in proper places

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

JOB SHEET #8--OPERATE AN IMPACT WRENCH TO REPLACE A GUARDRAIL

I. Equipment and materials

- A. Air compressor and air hose
- B. Impact wrench
- C. Sockets
- D. Nuts and bolts
- E. Guardrail section

II. Procedure

- A. Perform prestart inspection and maintenance
- B. Attach air hose to compressor and to wrench
- C. Start and warm up compressor
- D. Select the correct-sized socket and place it on wrench drive
- E. Set wrench to turn counterclockwise
- F. Open service valve on compressor
- G. Seat socket securely on nut

  (NOTE: Take care not to pinch your fingers.)

- H. Pull air trigger and remove nut
- I. Release trigger
- J. Repeat until all nuts are removed from guardrail
- K. Remove guardrail section

  (NOTE: Use proper lifting techniques; keep feet out from under guardrail.)

- L. Place new guardrail section on posts
- M. Replace nuts and start with fingers
- N. Set torque
- O. Set wrench to turn clockwise

JOB SHEET #8

P. Seat socket securely on nut

Q. Depress air trigger and drive nut until it is snug

R. Release air trigger and remove socket from nut

S. Repeat until all nuts are snug

T. Tighten all nuts to the correct torque

U. Shut off compressor

V. Relieve pressure from compressor

W. Depress air trigger on wrench to relieve pressure in hose

X. Disconnect wrench from hose

Y. Disconnect hose from compressor

Z. Store hose and wrench in proper places

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

TEST

NAME _____ SCORE _____

1. Match terms associated with air compressors and attachments to their correct definitions. Write the correct numbers in the blanks.

_____a. Cubic feet per minute

_____b. Machine that increases the pressure of air by increasing its density; used to power a variety of attachments

_____c. Placement of concrete on top of concrete that has already been placed and vibrated

_____d. Oil reservoir attached to air hose between compressor and attachment; keeps attachment lubricated during operation

_____e. Thickness of material spread in one layer

_____f. Leveling concrete slabs by drilling holes and pumping slurry mixture (mud) underneath

_____g. Air powered

_____h. Pounds per square inch

_____i. Accessories that increase a machine's versatility and effectiveness

_____j. Round-ended tool for breaking pavement

1. Repeated placement
2. Slab jacking
3. Pneumatic
4. Air compressor
5. psi
6. Air line lubricator
7. Lift
8. cfm
9. Moil
10. Attachments

2. Arrange in order stages in the compression cycle. Write a "1" before the first stage, a "2" before the second stage, and so on. Stages are continued on next page.

_____a. Oil and air mixture is directed into oil separator (receiver/separator system), which removes the oil

_____b. Air inlet port closes, trapping air inside rotors

_____c. Cooled lubricating oil is injected into compressed air

_____d. Rotors draw free air into compressor

TEST

_____e. Rotors mesh and decrease air volume, thereby increasing pressure

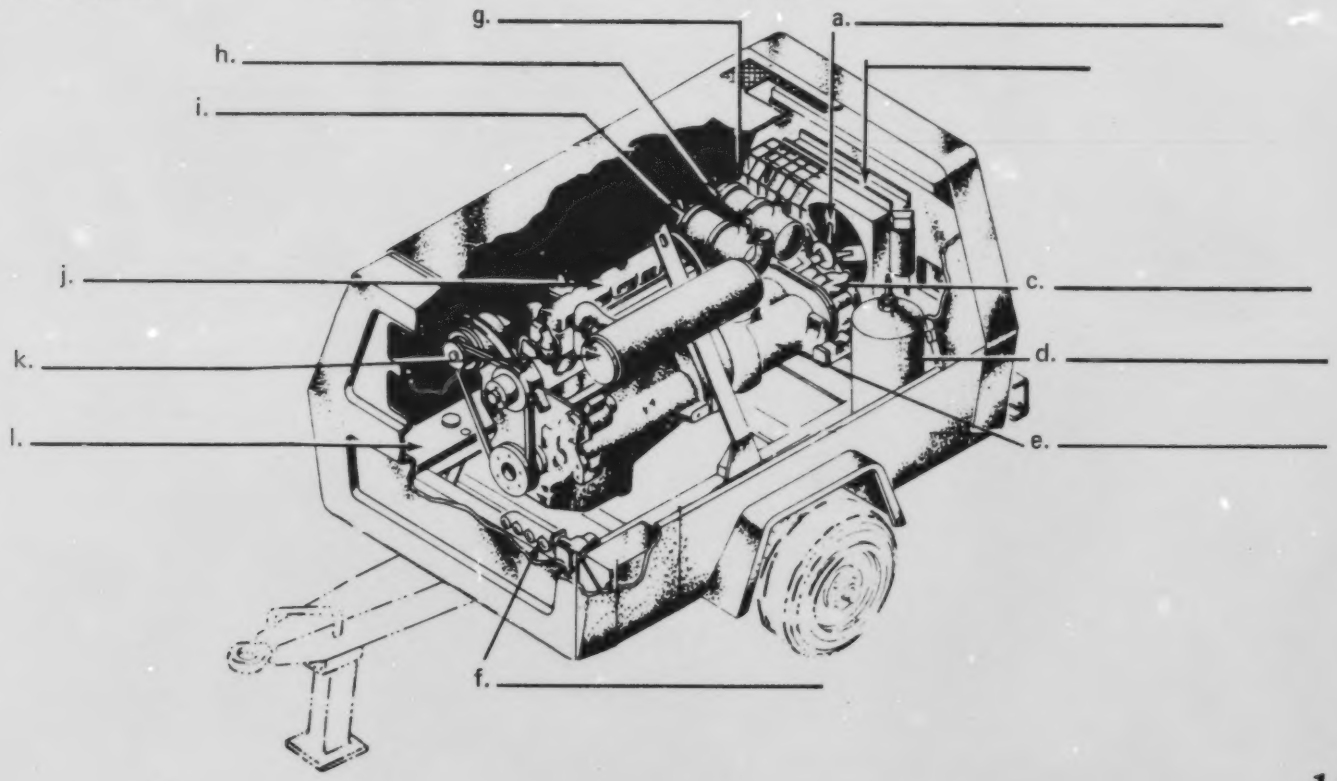
_____f. Compressed air is discharged through hose connectors

_____g. Compressed air moves toward discharge port

TEST

3. Identify the parts of an air compressor. Write the correct names in the blanks.

Fuel tank	Compressor air filter	Fan
Engine air filter	Hose connectors	Air end
Radiator	Exhaust	Compressor
Oil separator	Engine	Fan guard



TEST

4. Identify controls on a typical air compressor. Write the correct numbers in the blanks.

_____a. Tachometer/ hourmeter

_____b. Discharge check valve

_____c. Service valve

_____d. Fuel oil pressure switch

_____e. Starter

_____f. Compressor air temperature switch

_____g. Auxiliary service valve

_____h. Fuel shutoff

_____i. Compressor inlet valve

_____j. Safety valve

_____k. Automatic blowdown valve

_____l. Instrument panel

_____m. Manual blowdown valve

_____n. Hand throttle control lever

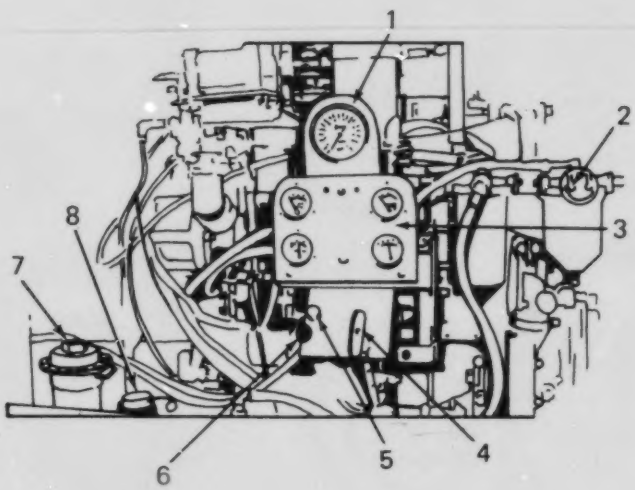
_____o. Fuel tank filler cap

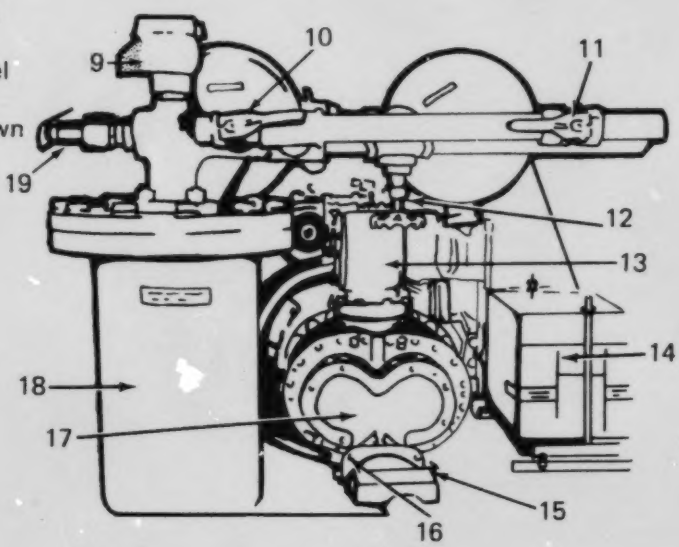
_____p. Fuel level gauge

_____q. Battery

_____r. Compressor

_____s. Oil separator





TEST

5. Match air compressor controls to their correct functions. Write the correct numbers in the blanks.

_____a. Sets engine speed

_____b. Releases compressed air from receiver/separator system when compressor is shut down

_____c. Indicates air pressure in receiver/separator system under various load and unload conditions

_____d. Registers engine rpm

_____e. Allows receiver/separator system to be relieved of all pressure

_____f. Regulates amount of air passing through compressor system

_____g. Vents separator pressure when inside pressure exceeds maximum operating pressure

_____h. Registers hours of operation

_____i. Regulates engine speed and air volume delivery

_____j. Monitors temperature of engine oil

_____k. Monitors temperature of engine water

_____l. Cuts off reverse flow of air/oil mixture through compressor discharge system when compressor is shut down

_____m. Indicates oil level in oil separator

_____n. Cranks engine

1. Pressure regulator
2. Tachometer
3. Discharge check valve
4. Hourmeter
5. Automatic blowdown valve
6. Hand throttle control lever
7. Engine oil temperature gauge
8. Pressure relief valve (safety valve)
9. Oil level sight glass
10. Manual blowdown valve
11. Starter
12. Engine water temperature gauge
13. Discharge pressure gauge
14. Service valve

TEST

6. List twelve safety rules for operating an air compressor.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

j. _____

k. _____

l. _____

7. Select from the following list procedures for effective compressor operation. Write an "X" in the blank before each correct answer.

_____a. Operate with side doors closed

_____b. Perform all prestart inspection and maintenance procedures

_____c. Keep manual blowdown valve open

_____d. Check gauges often during operation

_____e. Close service valves and manual blowdown valve when starting compressor

_____f. Keep full pressure in tank at all times

_____g. Keep unit as level as possible

_____h. Operate at full throttle under most circumstances

_____i. Check air cleaner weekly

_____j. Operate with side doors open unless manufacturer recommends otherwise

TEST

8. Match compressor attachments to their correct uses. Write the correct numbers in the blanks.

_____a. Used to drill holes in concrete

_____b. Used to compact material

_____c. Used to break up concrete, boulders (to be used as fill), asphalt mats, and hard earth; also used for cutting lines to repair potholes

_____d. Used to remove air bubbles in concrete to settle the concrete close against forms and reinforcing steel

_____e. Used to loosen or tighten bolts

_____f. Used to cut bridge timbers, even tops of guard posts, and clear brush

1. Vibrator
2. Impact wrench
3. Rock drill (jackhammer)
4. Tamper
5. Paving breaker
6. Saw

9. List ten safety rules for operating compressor attachments.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

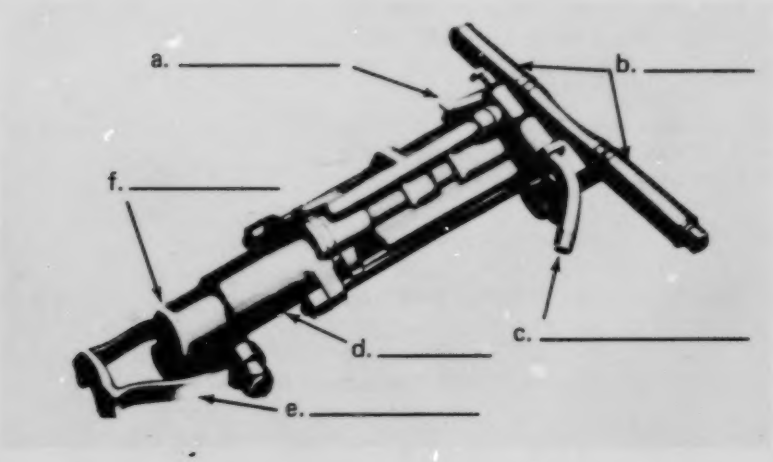
i. _____

j. _____

TEST

10. Identify the parts of a rock drill. Write the correct names in the blanks.

Chuck	Handles
Cylinder	Latch retainer
Air hose connection	Air valve



11. Select from the following list procedures for safe and effective rock drill operation. Write an "X" in the blank before each correct answer.

_____ a. Check tightness of all bolts, nuts, and fittings once per day

_____ b. Blow out hole frequently during drilling

_____ c. Be sure that shank and bit are tightly secured

_____ d. Drill to desired depth before blowing out hole

_____ e. Check tightness of all bolts, nuts, and fittings several times a day

_____ f. Check oil level in lubricator often

_____ g. Keep drill straight when drilling straight down

_____ h. Use a firm grip and apply just enough downward pressure to keep drill from bouncing

_____ i. Check oil in lubricator every other day

TEST

_____j. Place drill between feet to start drilling

_____k. Leave drill standing in hole while you shut off compressor

_____l. Force drill only as much as is needed to start it boring downward

_____m. Use extra caution when drilling at an angle

12. Identify the parts of a paving breaker. Write the correct numbers in the blanks.

_____a. Air hose connection

_____b. Tool

_____c. Handle

_____d. Chuck

_____e. Stem

_____f. Throttle (spring loaded)

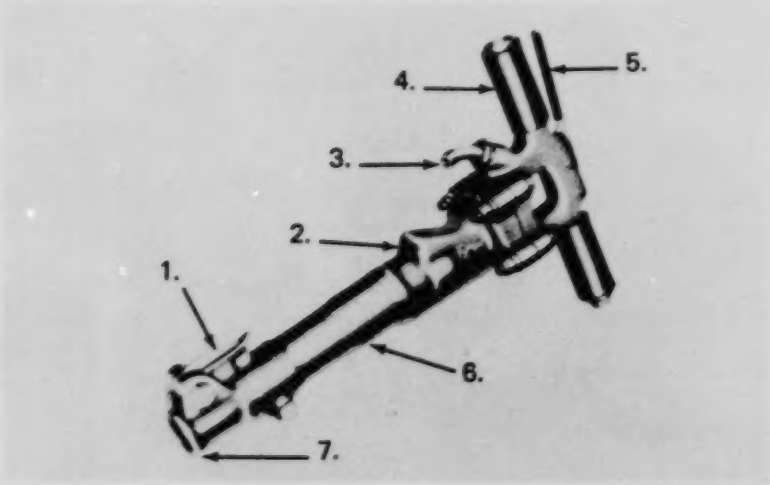
_____g. Retainer latch

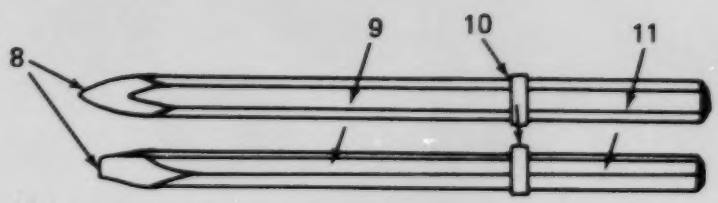
_____h. Shank

_____i. Cylinder and piston

_____j. Collar

_____k. Exhaust





TEST

13. Match paving breaker tools to their correct uses. Write the correct numbers in the blanks.

_____a. Used for cutting a straight line in asphalt

_____b. Used for digging footings and ditches in soft soils, and for shaping sides of ditches

_____c. Used for cutting narrow, deep ditches

_____d. Used for breaking hard materials such as concrete, asphalt, and rock

_____e. Used for compacting soil

_____f. Used for breaking up concrete

_____g. Used for shaping and finishing edges on concrete, slate, and other materials

_____h. Used for lifting cut asphalt

1. Spear- or narrow-point chisel
2. Clay spade
3. Asphalt cutter
4. Square and round dirt tampers
5. Digging chisel
6. Standard 3-inch chisel
7. Moil-point tool
8. Asphalt wedge

14. Select from the following list procedures for safe and effective paving breaker operation. Write an "X" in the blank before each correct answer.

_____a. Begin breaking concrete at corners

_____b. Check tightness of all bolts, nuts, and fittings daily

_____c. Turn power on, then set breaker in position to cut or break

_____d. Bear down at an angle to break asphalt loose

_____e. Keep feet close to tool for a firm footing

_____f. Begin removing asphalt on one end, and work from side to side between cuts

_____g. Keep hose away from you

_____h. Begin removing asphalt at corners

_____i. Impact until bit stops

_____j. Check tightness of all bolts, nuts, and fittings every two hundred hours

_____k. Set breaker in position to cut or break before turning on power

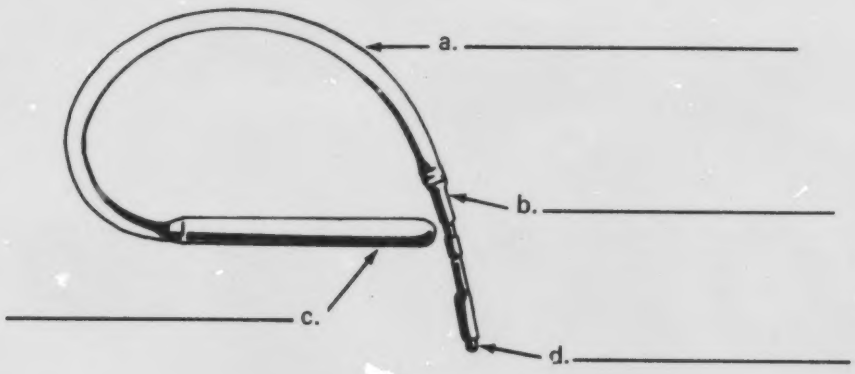
_____l. Keep feet clear of attachment tool

_____m. Check oil level in lubricator often

TEST

15. Identify the parts of a pneumatic vibrator. Write the correct names in the blanks.

Twist throttle
Vibrator head
Air connection
Air and exhaust hose



16. Select from the following list procedures for safe and effective vibrator operation. Write an "X" in the blank before each correct answer.

_____a. Retract vibrator rapidly

_____b. Retract vibrator slowly

_____c. Insert vibrator to full depth of newly poured concrete

_____d. Keep toes and feet clear

_____e. Pull vibrator out underhand

_____f. Lift vibrator straight out, close to the body

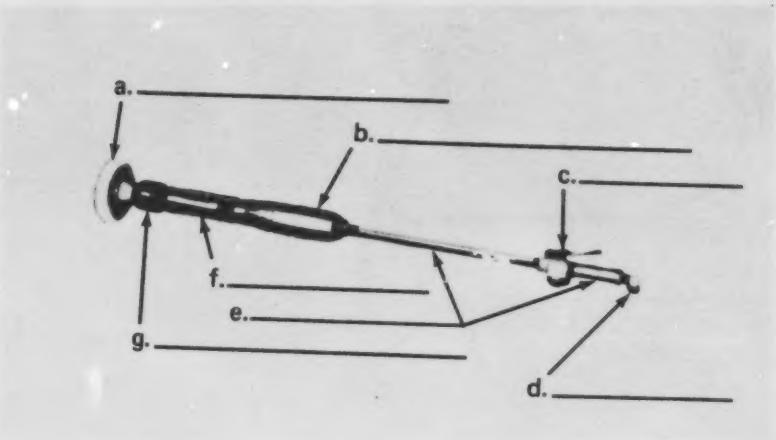
_____g. Pull vibrator out overhand

_____h. Insert vibrator as far as your reach will allow

TEST

17. Identify the parts of a tamper. Write the correct names in the blanks.

Pipe	Oil reservoir
Air valve	Air hose connection
Cylinder	Butt lock screw
Butt	



18. Select from the following list procedures for safe and effective tamper operation. Write an "X" in the blank before each correct answer.

_____a. Work back and forth across the shortest distance

_____b. Work as quickly as possible

_____c. Guide machine; do not force

_____d. Keep feet clear of tamper

_____e. Keep muscles tense to avoid accidents

_____f. Tamp each section until the desired compaction is reached

_____g. Remove hose from tamper; then shut down compressor when job is completed

_____h. Wear insulated gloves

_____i. Use enough force to keep tamper moving at maximum speed

TEST

_____j. Tamp from side to side

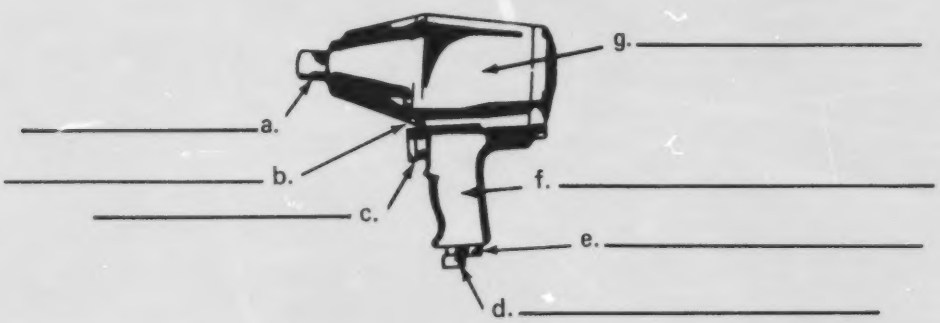
_____k. Work a small section; then move tamper to overlap that section

_____l. Tamp toward you and away from you

_____m. Allow tamped section to "set" before applying a second treatment

19. Identify the parts of an impact wrench. Write the correct names in the blanks.

Drive	**Pneumatic motor**	**Torque adjustment dial**
Air hose connection	**Air trigger**	**Direction control**
Handle		



20. Select from the following list procedures for safe and effective impact wrench operation. Write an "X" in the blank before each correct answer.

_____a. Before operating, set torque to desired tension

_____b. Drop wrench on floor after bolt is removed or tightened

_____c. Wear insulated gloves

_____d. Take care not to pinch your fingers when putting drive on bolt

_____e. Wear gloves only when seating wrench on bolt

_____f. Tighten bolts until correct torque is reached

_____g. Be sure wrench is well seated on bolt before turning on power

_____h. Do not wear gloves

TEST

_____i. Set wrench to turn counterclockwise to tighten bolts or clockwise to loosen bolts

_____j. Set wrench to turn clockwise to tighten bolts or counterclockwise to loosen bolts

21. Match air compressor and attachments to their recommended safety equipment. Write the correct numbers in the blanks. Some blanks require more than one answer.

_____a. Close-fitting clothing

_____b. Goggles

_____c. Hard hat

_____d. Gloves

_____e. Hard-toed shoes

_____f. Ear protection

1. Compressor and all attachments
2. Impact wrench
3. Paving breaker
4. Rock drill
5. Tamper
6. Compressor

(NOTE: Question 22 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

22. Demonstrate the ability to

a. Perform prestart inspection and maintenance procedures on an air compressor.

b. Service an air compressor.

c. Start, warm up, operate, and shut down an air compressor.

d. Operate a rock drill to drill a 2-inch hole in concrete or asphalt pavement.

e. Operate a paving breaker to break a section of concrete.

f. Operate a pneumatic vibrator to vibrate a concrete patch.

g. Operate a pneumatic tamper to compact backfill around a box culvert.

h. Operate an impact wrench to replace a guardrail.

AIR COMPRESSORS AND ATTACHMENTS
UNIT II

ANSWERS TO TEST

1. a. 8
   b. 4
   c. 1
   d. 6
   e. 7
   f. 2
   g. 3
   h. 5
   i. 10
   j. 9

2. a. 6
   b. 2
   c. 5
   d. 1
   e. 3
   f. 7
   g. 4

3. a. Fan
   b. Radiator
   c. Air end
   d. Oil separator
   e. Compressor
   f. Hose connectors
   g. Fan guard
   h. Engine air filter
   i. Compressor air filter
   j. Engine
   k. Exhaust
   l. Fuel tank

ANSWERS TO TEST

4.

a.	1	h.	6	o.	7
b.	16	i.	13	p.	8
c.	12	j.	19	q.	14
d.	2	k.	9	r.	17
e.	5	l.	3	s.	18
f.	15	m.	10		
g.	11	n.	4		

5.

a.	6	h.	4
b.	5	i.	1
c.	13	j.	7
d.	2	k.	12
e.	10	l.	3
f.	14	m.	9
g.	8	n.	11

6. Answer should include any twelve of the following

   a. Read operator's manual thoroughly; know your machine

   b. Study departmental safety manual

   c. Wear close-fitting clothing; keep long hair tied back

   d. Keep hands, arms, and clothing away from belts, pulleys, and other moving parts

   e. Be sure that all guards and shields are in good working order and in place at all times

   f. Make sure that all personnel are clear of compressor before starting or operating it

   g. Make adjustments only when engine is shut off

   h. Keep away from all points of air discharge and away from hot exhaust gases

   i. Be sure that all connections and couplings are *completely* interlocked and pinned

ANSWERS TO TEST

j. Set up compressor in a location that is as level as possible

k. Block wheels

l. Do not smoke when fueling compressor

m. Make sure that all warning and safety devices are working properly

n. Use extra caution when injecting ether or other cold-weather starting aids

o. Do not exceed recommended maximum air pressure

p. Be sure that *all pressure* has been released before disconnecting hoses

q. Keep compressor clean

7. b, d, e, g, h, j

8. a. 3

b. 4

c. 5

d. 1

e. 2

f. 6

9. Answer should include any ten of the following

a. Study departmental safety manual for each tool

b. Wear protective devices for attachment tool you are using

c. Operate from a well-balanced, comfortable position

d. Work relaxed

e. Keep hands and feet away from moving parts as much as possible

f. Use correct lifting techniques

g. Check all connections before operating attachment tools

h. Be sure that chucks and retainers are tight and are holding shank securely

i. Position yourself so that initial burst of air will not hit you

ANSWERS TO TEST

j. Keep feet away from hose

k. Keep hose away from working attachment tool

l. Before disconnecting hose from attachment, shut off air compressor, and then release pressure from attachment

10. a. Air valve

b. Handles

c. Air hose connection

d. Cylinder

e. Latch retainer

f. Chuck

11. b, c, e, f, g, h, j, k, m

12.

a.	3	g.	1
b.	8	h.	11
c.	4	i.	6
d.	7	j.	10
e.	9	k.	2
f.	5		

13.

a.	3	e.	4
b.	2	f.	6
c.	5	g.	1
d.	7	h.	8

14. a, b, d, f, g, k, l, m

ANSWERS TO TEST

15. a. Air and exhaust hose
    b. Twist throttle
    c. Vibrator head
    d. Air connection

16. b, c, d, f, g

17. a. Butt
    b. Oil reservoir
    c. Air valve
    d. Air hose connection
    e. Pipe
    f. Cylinder
    g. Butt lock screw

18. a, c, d, f, h, j, k

19. a. Drive
    b. Direction control
    c. Air trigger
    d. Air hose connection
    e. Torque adjustment dial
    f. Handle
    g. Pneumatic motor

20. a, d, f, g, h, j

21. a. 1
    b. 3, 4, 6
    c. 1
    d. 3, 4, 5, 6
    e. 1
    f. 1

22. Performance skills evaluated to the satisfaction of the instructor

SWEEPERS
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to operate towed and self-propelled sweepers (power brooms) safely and effectively. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with sweepers to their correct definitions.
2. Select from a list uses of sweepers in highway maintenance.
3. Identify the parts of a towed sweeper.
4. Identify the parts of self-propelled sweeper.
5. Identify controls on a typical self-propelled sweeper.
6. State safety rules for operating a sweeper.
7. Match types of brooms to their correct descriptions.
8. State procedures for effective sweeper operation.
9. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a towed sweeper.
    b. Service a towed sweeper.
    c. Perform prestart inspection and maintenance procedures on a self-propelled sweeper.
    d. Service a self-propelled sweeper.
    e. Attach, adjust, tow, operate, and shut down a towed sweeper.
    f. Start, warm up, operate, and shut down a self-propelled sweeper.
    g. Replace wafer bristles.
    h. Sweep roadway with a towed sweeper.
    i. Sweep roadway with a self-propelled sweeper.

SWEEPERS
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order materials to supplement unit.

1. Operation and maintenance manuals for equipment to be used.

2. Sales literature from distributors showing different sweeper models available.

B. Provide students with objective sheet.

C. Provide students with information and job sheets.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss procedures outlined in job sheets.

G. Provide alternate jobs if those in job sheets are not practical.

H. Stress that each model will have different control arrangements.

I. Stress the use of respirators for sweeping operations.

J. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Towed Sweeper

2. Job Sheet #2--Service a Towed Sweeper

3. Job Sheet #3--Perform Prestart Inspection and Maintenance Procedures on a Self-Propelled Sweeper

4. Job Sheet #4--Service a Self-Propelled Sweeper

SUGGESTED ACTIVITIES

5. Job Sheet #5--Attach, Adjust, Tow, Operate, and Shut Down a Towed Sweeper

6. Job Sheet #6--Start, Warm Up, Operate, and Shut Down a Self-Propelled Sweeper

7. Job Sheet #7--Replace Wafer Bristles

8. Job Sheet #8--Sweep Roadway with a Towed Sweeper

9. Job Sheet #9--Sweep Roadway with a Self-Propelled Sweeper

E. Test

F. Answers to test

III. Unit references

A. *Construction Equipment Operator Volume 3,* AFSC 55151.

B. *Installation Procedures for Wafer Brushes.* Peoria, Illinois: Little Giant Products, Inc., n.d.

C. *Operating and Maintenance Instructions, Rosco Hydra-Sweep Road and Street Broom, Model BH-7.* Minneapolis, Minnesota: Rosco Manufacturing Company, n.d.

D. *Operating and Maintenance Manual, Model C.* Dodge City, Kansas: Broce Broom, n.d.

E. *Parts and Operating Manual, B7 and B8 Road Sweepers.* Minneapolis, Minnesota: Rosco Manufacturing Company, n.d.

F. *Service Manual and Parts List, Hyport Sweeper.* Peoria, Illinois: Little Giant Products, Inc., 1965.

G. *Service Manual and Parts List, Little Giant Sweepers.* Peoria, Illinois: Little Giant Products, Inc., 1973.

SWEEPERS
UNIT III

INFORMATION SHEET

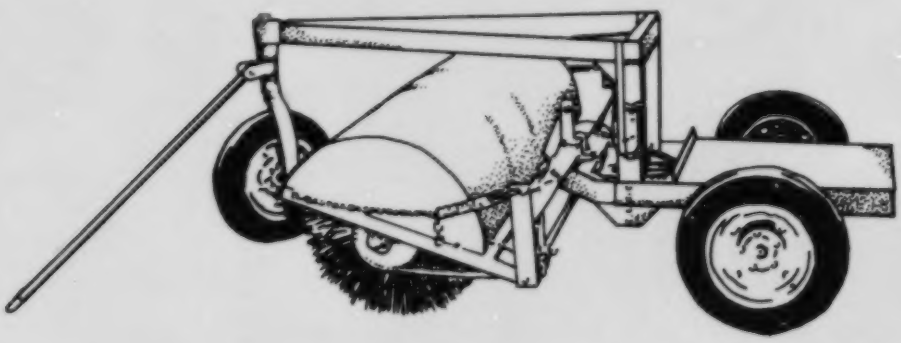
I. Terms and definitions

A. Sweeper (power broom)--Machine that sweeps debris off roadway onto shoulders and into piles or windrows where it can be picked up manually or with a vacuum sweeper (Figures 1-3)

(NOTE: Sweepers may be towed or self-propelled. Towed sweepers may be traction-powered or engine-powered. Brush adjusts for height and angle.)

EXAMPLE: Traction-powered towed sweeper

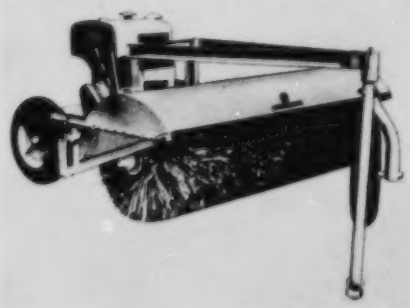
FIGURE 1



Used with permission of Little Giant Products, Division of Waldon, Inc., Fairview, Oklahoma.

EXAMPLE: Engine-powered towed sweeper

FIGURE 2



Courtesy of Little Giant Products, Division of Waldon, Inc., Fairview, Oklahoma.

INFORMATION SHEET

EXAMPLE: Self-propelled sweeper

FIGURE 3

Courtesy of Broce Manufacturing Company, Dodge City, Kansas.

B. Traction-powered--Rotation of broom powered by rear wheels of towing vehicle

C. Tow vehicle--Truck or tractor that tows accessory

D. Sweeping pattern--Area of ground/broom contact

II. Uses of sweepers in highway maintenance

A. Cleaning paved surfaces for chip sealing

B. Sweeping away excess chips after chip sealing

C. Broom dragging

D. Cleaning roadways of sand and salt after ice control operations

(NOTE: After snow has melted and pavement is dry, salt and sand are removed to prevent corrosion.)

E. Sweeping maintenance yard

F. Cleaning road surfaces before striping

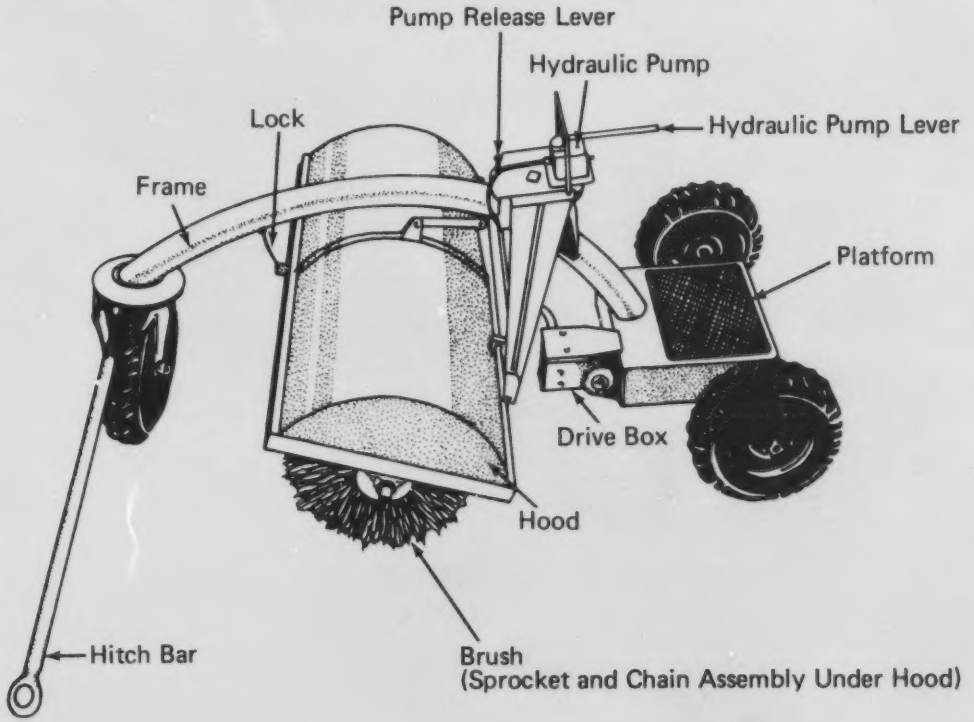
G. Routine grooming of bridges and roadways

INFORMATION SHEET

III. Parts of a towed sweeper (Figure 4; Job Sheets #1 and #2)

(NOTE: The hydraulic pump raises and lowers the broom and sets the pressure. Some models are equipped with tension chains that secure the broom to the frame and assist in pressure adjustment.)

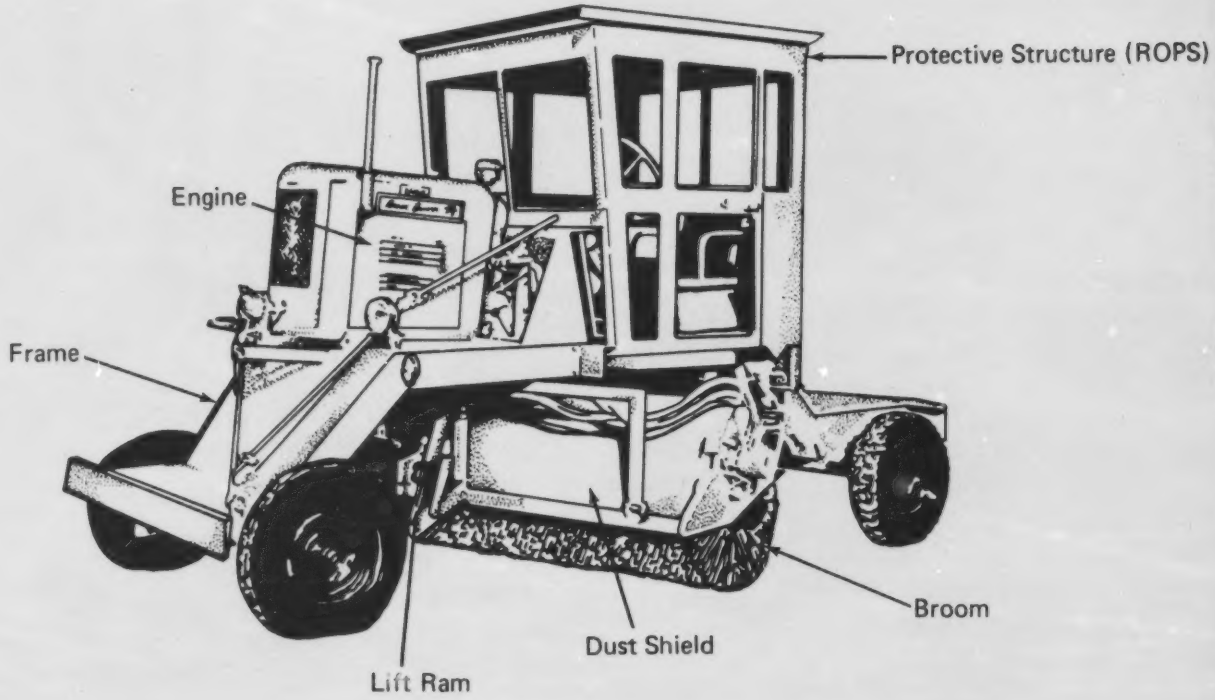
FIGURE 4



INFORMATION SHEET

IV. Parts of a self-propelled sweeper (Figure 5; Job Sheets #3 and #4)

FIGURE 5



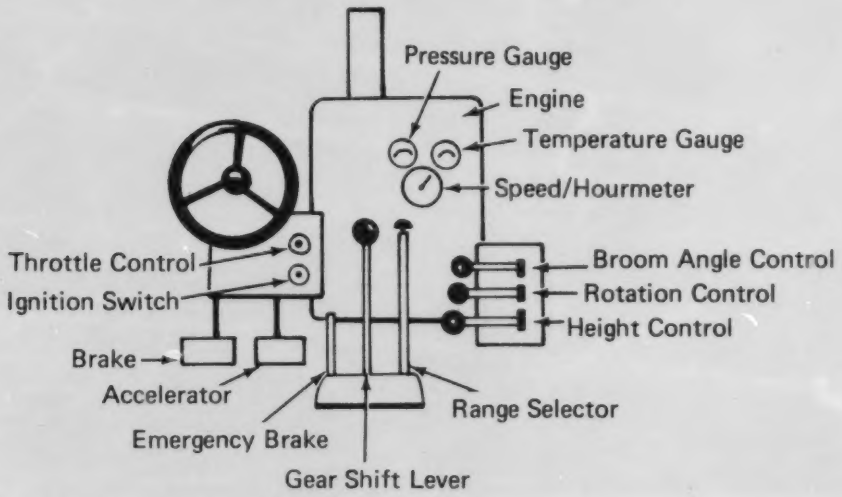
Adapted with permission of Broce Manufacturing Company, Dodge City, Kansas.

INFORMATION SHEET

V. Controls on a typical self-propelled sweeper (Figure 6; Job Sheet #6)

(NOTE: Controls and control locations will vary with manufacturer and model. The model shown below has hydrostatic drive. In a manual transmission, the clutch is located in the same place as it is in a truck.)

FIGURE 6



A. Brake--Stops sweeper movement

B. Accelerator--Controls engine speed and forward and reverse movement of sweeper

C. Gear shift lever--Selects transmission gear

D. Range selector--Selects high or low gear range

E. Emergency brake--Secures sweeper when sweeper is stopped or parked

F. Throttle control--Sets constant speed for broom rotation

G. Ignition switch--Starts or stops engine

H. Broom angle control--Sets broom at a 45-degree angle to right or left

I. Rotation control--Turns broom on or off

J. Height control--Raises or lowers broom

K. Speedometer/hourmeter--Indicates driving speed and hours of operation

L. Pressure gauge--Registers air pressure

M. Temperature gauge--Registers engine operating temperature

INFORMATION SHEET

VI. Safety rules for operating a sweeper

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear goggles, close-fitting clothing, and respirator

D. Attach and check safety chains

E. Make sure that all personnel and obstructions are cleared from area before operating machine

F. Watch for other equipment in area

G. Use warning lights at all times

H. Use SMV emblem

I. Use grab irons and steps

J. Dismount only after all movement stops

K. Do not leave machine running unattended

L. Use care when sweeping overpasses

(NOTE: Do not sweep rock and debris onto cars underneath overpass.)

M. Keep equipment clean

INFORMATION SHEET

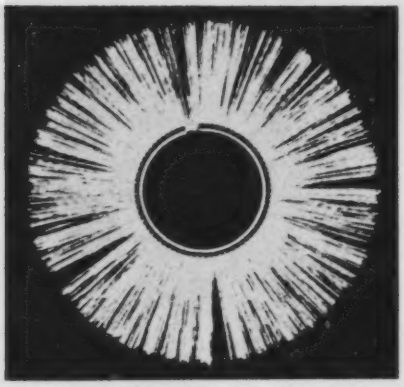
VII. Types of brooms and their descriptions (Figures 7-11; Job Sheet #7)

(NOTE: Brooms may have nylon, plastic, or wire fibers. The different types of construction apply to installation and replacement.)

A. Wafer--Disc that slips onto a metal core

EXAMPLE: Wafer brush

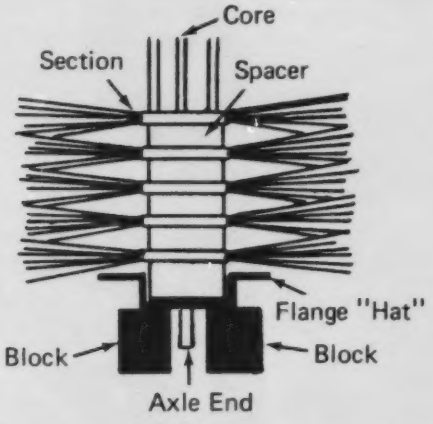
FIGURE 7



Courtesy of Little Giant Products, Inc., Division of Waldon, Inc., Fairview, Oklahoma.

EXAMPLE: Wafers mounted on core

FIGURE 8

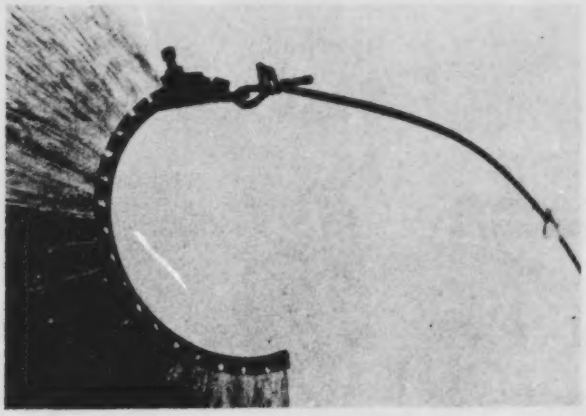


Used with permission of Rosco Manufacturing, Minneapolis, Minnesota.

B. Coil brush--Continuous bristles that screw into a cable-grooved core

EXAMPLE: Coil brush

FIGURE 9

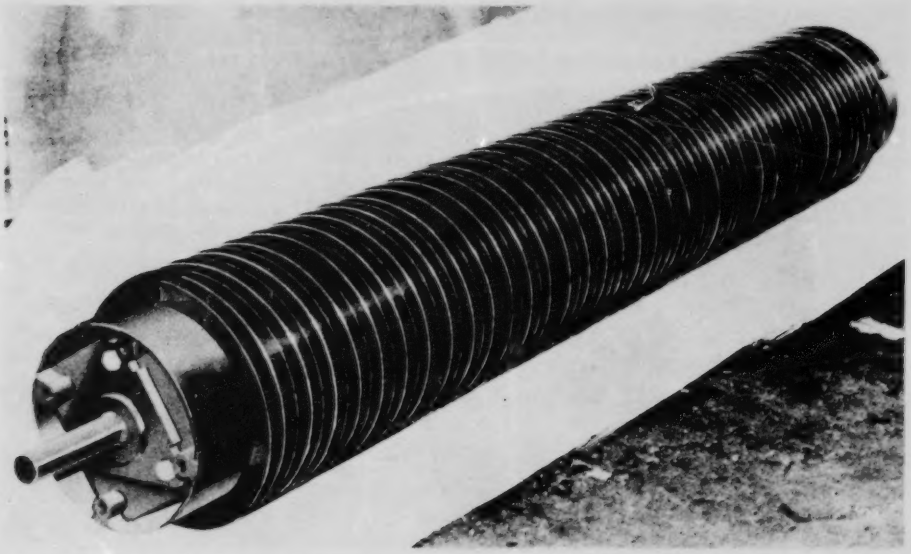


Courtesy of Little Giant Products, Inc., Division of Waldon, Inc., Fairview, Oklahoma.

INFORMATION SHEET

EXAMPLE: Coil and cable wrap core

FIGURE 10

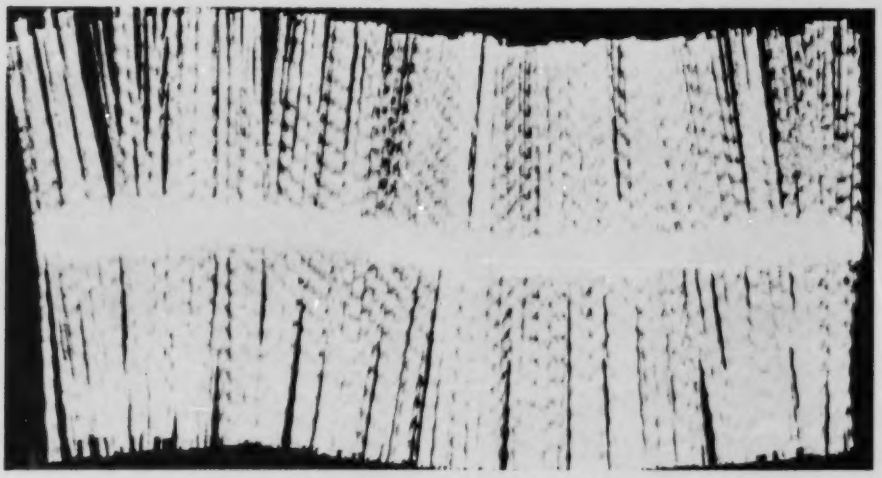


Courtesy of Little Giant Products, Inc., Division of Waldon, Inc., Fairview, Oklahoma.

C. Bulk fiber--Bristle mat fitted to a coil and cable-wrap core with an automatic broom-filling machine

EXAMPLE: Bulk fiber brush

FIGURE 11



Courtesy of Little Giant Products, Division of Waldon, Inc., Fairview, Oklahoma.

INFORMATION SHEET

VIII. Procedures for effective operation (Job Sheets #5, #8, and #9)

A. Perform all required maintenance procedures

B. Gear transmission to regulated ground speed

C. Operate sweeper at full throttle

D. Raise broom completely off ground before transporting

E. Do not allow engine to run for long periods when machine is not in use

(NOTE: Hydraulic pumps continue to operate, causing heat and undue wear on the system.)

F. Operate hydraulic valve handles slowly

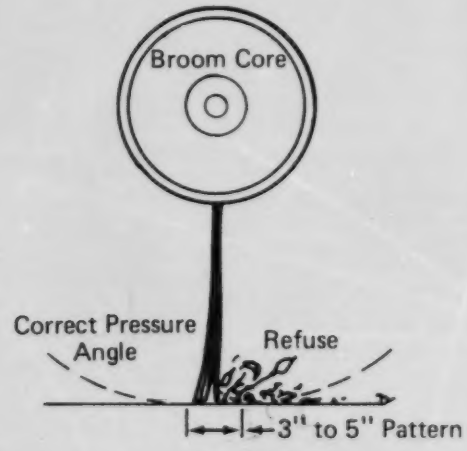
(NOTE: Do not surge the hydraulic system.)

G. Use correct broom setting

(NOTE: Sweep; don't mop! Light broom pressure on the pavement cleans best. The broom fibers get behind the dirt and pick it up [Figure 12]. Too much pressure rubs the dirt into the pavement, resulting in excessive broom wear, a poor sweeping job, and unnecessary strain on all sweeper mechanisms [Figure 13]. Manufacturer's recommenadations vary from 2 inches to 5 inches. Check operator's manual.)

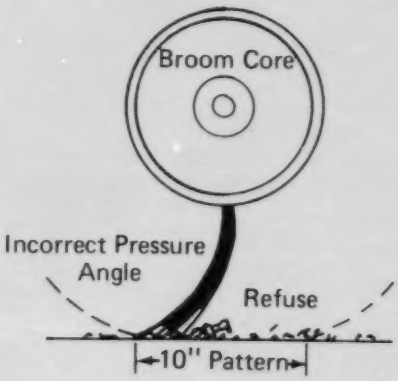
EXAMPLE: Correct broom setting

FIGURE 12



EXAMPLE: Incorrect broom setting

FIGURE 13



Illustrations in Figures 12 and 13 used with permission of Little Giant Products, Division of Waldon, Inc., Fairview, Oklahoma.

INFORMATION SHEET

H. For heavy sweeping, use slower forward speed and increase brush revolutions per minute (rpm)

(NOTE: Setting should not exceed 7 inches even in heavy dirt conditions. Down pressure on the broom *will not* increase effectiveness.)

I. Increase broom setting for problem areas, and then reset immediately

EXAMPLES: Deep gutters, broken pavement, potholes

J. Set broom at an angle to sweep curbs

K. Operate at best speed for conditions

EXAMPLES: Normal conditions--10 to 12 mph
Heavy dirt conditions--3 to 5 mph
Towed sweeper--4 to 5 mph

L. On two-way highway, start at center and sweep to shoulder

M. On divided highway, start at inside curb and work to outside curb

N. Remove and clean air filter twice daily in extremely dusty conditions

O. Replace brush assembly when worn

(NOTE: Replace brush when bristles no longer sweep clean or when brush is worn to approximately 8 inches in diameter.)

P. Clean brush thoroughly after use

SWEEPERS
UNIT III

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A TOWED SWEEPER

I. Equipment and materials

A. Engine-powered towed sweeper

B. Operator's manual

C. Lubricants

1. Engine oil

2. Chassis grease

3. Light oil

D. Grease gun

E. Water

F. Tool kit

G. Fuel

H. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

C. Check air cleaner filter element; clean and replace if necessary

(NOTE: Remove and clean air filter element twice daily in extremely dusty conditions.)

D. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

E. Clean and lubricate fittings according to operator's manual

F. Check battery water level and connections; add water if needed

JOB SHEET #1

G. Check chain tension; adjust if necessary

(NOTE: Keep 1/4 inch to 3/4 inch sag on chains.)

H. Check brush for wear; replace if necessary

(NOTE: Replace brush when it is worn to approximately an 8-inch radius or when brush does not sweep clean.)

I. Check fuel level; fill fuel tank if necessary

J. Check all safety devices

K. Check tires

L. Clean up any spilled grease

SWEEPERS
UNIT III

JOB SHEET #2--SERVICE A TOWED SWEEPER

I. Equipment and materials

A. Engine-powered towed sweeper

B. Operator's manual

C. Tool kit

D. Air supply

E. Grease gun

F. Lubricants

G. Cleaning solvents

H. Rags

I. Water

J. Engine coolant

K. Engine oil

L. Hydraulic fluid

M. Tire pressure gauge

N. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

C. Check engine coolant level, radiator cap, hoses, and radiator; add coolant if necessary

(CAUTION: Do not remove radiator cap unless engine is cool; then open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

JOB SHEET #2

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

G. Check drive belts for tension and wear; adjust or replace if necessary

H. Check wiring, insulation, and connections

I. Clean and lubricate all grease fittings according to operator's manual

J. Check condition of tires

K. Check tire pressure; inflate to recommended pressure if necessary

L. Check all safety devices; repair if necessary

M. Check major components and/or accessories

1. Clean and lightly oil chains
2. Check battery water level and connections, if machine is so equipped; add water if needed
3. Check chain tension; adjust if necessary
4. Check brush for wear; replace if necessary

SWEEPERS
UNIT III

JOB SHEET #3--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A SELF-PROPELLED SWEEPER

I. Equipment and materials

A. Self-propelled sweeper

B. Operator's manual

C. Engine oil

D. Engine coolant

E. Hydraulic fluid

F. Fuel

G. Lubricants

H. Grease gun

I. Rags

J. Tire pressure gauge

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level; add engine oil if needed

C. Check engine coolant level; add coolant if needed

D. Check hydraulic reservoir level; add fluid if needed

E. Check fuel level; fill tank if necessary

F. Check battery connections for tightness and corrosion

G. Check battery electrolyte level; add water if needed

H. Check air cleaner; remove and clean filter if necessary

I. Check brakes

J. Check tire pressure; inflate to recommended pressure if necessary

JOB SHEET #3

K. Clean and lubricate all grease fittings according to operator's manual

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections and insulation

O. Clean windshield and mirrors; adjust mirrors

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check broom for wear; replace if necessary

SWEEPERS
UNIT III

JOB SHEET #4--SERVICE A SELF-PROPELLED SWEEPER

I. Equipment and materials

A. Self-propelled sweeper

B. Operator's manual

C. Tool kit

D. Air supply

E. Grease gun

F. Lubricants

G. Cleaning solvents

H. Rags

I. Water

J. Engine coolant

K. Engine oil

L. Hydraulic fluid

M. Transmission fluid

N. Brake fluid

O. Tire pressure gauge

P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add or change engine oil if necessary

JOB SHEET #4

C. Check engine coolant level, radiator cap, hoses, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; fill if necessary

M. Check clutch adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate all grease fittings according to operator's manual

Q. Check condition of tires

R. Check tire pressure; inflate to recommended pressure if necessary

S. Check all safety devices; repair if necessary

T. Check windshield and windshield wipers; clean if necessary

U. Check broom for wear; replace if necessary

SWEEPERS
UNIT III

JOB SHEET #5--ATTACH, ADJUST, TOW, OPERATE, AND SHUT DOWN A TOWED SWEEPER

I. Equipment and materials

A. Towed sweeper

B. Operator's manual

C. Tow vehicle

D. Sand

E. Shovel

F. Hose and water

II. Procedure

A. Attach sweeper unit to tow vehicle

B. Check that cotter pin and safety chains are securely fastened

C. Attach hydraulic lines

D. Spread sand over an area larger than broom

E. Tow broom over sanded area

F. Set brake

G. Release safety chains and lower broom onto sand, using hand hydraulic pump, manual lever, or crank

(NOTE: It may be necessary to raise broom slightly in order to free chains. Lower broom so that bristles just touch the ground.)

H. Reinstall chains; set lock

I. Crank engine

J. Engage clutch; let brush revolve

K. Disengage clutch

L. Raise broom; measure cleared area

(NOTE: This is your sweeping pattern. It should be within the limits suggested by the manufacturer. If pattern is too wide, raise broom slightly until properly adjusted. If pattern is too narrow, increase down pressure. *Pattern should never exceed 7 inches.)*

JOB SHEET #5

M. Release chains and/or lock; raise broom to travel position and reinstall chains or lock

(NOTE: If unit has hydraulic hand pump to raise and lower broom, turn release valve or lever so that there is no pressure in the line during towing.)

N. Tow to job site

O. Set parking brake

P. Release safety chains and/or lock and lower broom

Q. Set broom angle at 15 to 30 degrees to sweep dirt off road onto shoulder

R. With clutch disengaged, repeat sweeping pattern procedure, adjusting pressure for specific conditions

S. Engage clutch

T. Sweep roadway

U. At end of operation, stop tow vehicle and set brake

V. Disengage clutch; shut down engine (if engine-powered)

W. Raise broom for transport

X. Attach and secure safety chains or lock

Y. Return to yard

Z. Thoroughly clean brush by hosing down with water

AA. Disconnect hydraulic lines

BB. Disconnect sweeper from tow vehicle

(NOTE: If storing, set sweeper on concrete blocks.)

SWEEPERS
UNIT III

JOB SHEET #6--START, WARM-UP, OPERATE, AND SHUT DOWN A SELF-PROPELLED SWEEPER

I. Equipment and materials

A. Self-propelled sweeper

B. Operator's manual

C. Wheel blocks

II. Procedure

A. Perform all prestart inspection and maintenance procedures

B. Mount sweeper using steps and grab irons

C. Make certain that emergency brake is set

D. Place all control levers in NEUTRAL position

E. Insert key and switch to ON position

F. Allow engine to warm up

G. Check gauges

H. Position broom to correct sweeping position

I. Depress clutch if machine is so equipped

J. Shift to low gear range

K. Set broom in FLOAT position

(NOTE: See operator's manual for recommended down pressure and sweep pattern.)

L. Increase rpm to approximately one-half throttle

M. Activate broom rotation throttle

N. Release clutch and move forward

O. Increase engine speed to full throttle

(NOTE: In order to maintain full hydraulic pressure and volume, maintain full engine speed at all times while the broom is in operation. Control ground speed with gear range.)

JOB SHEET #6

P. Practice steering and operating sweeper

Q. Stop sweeper by applying brakes; operate in reverse

(NOTE: Check operator's manual for specific procedures.)

R. To shut down sweeper, park machine on ground as level as possible

S. Deactivate broom rotation

T. Lower broom so that it just rests on ground

(NOTE: Too much pressure will bend the bristles.)

U. Place all control levers in neutral position

V. Set emergency brake

W. Allow engine to cool for one to two minutes

X. Turn ignition switch to OFF position

Y. Dismount properly and safely

Z. Block wheels

AA. Make final visual inspection for leaks and broken, worn, or missing parts; note any deficiencies and report them to proper authority

SWEEPERS
UNIT III

JOB SHEET #7--REPLACE WAFER BRISTLES

I. Equipment and materials

A. Wafer-type broom

B. 1/2-inch hexagonal wrench (check specific brush)

C. Two blocks

II. Procedure

A. Remove bearing bolts and chain

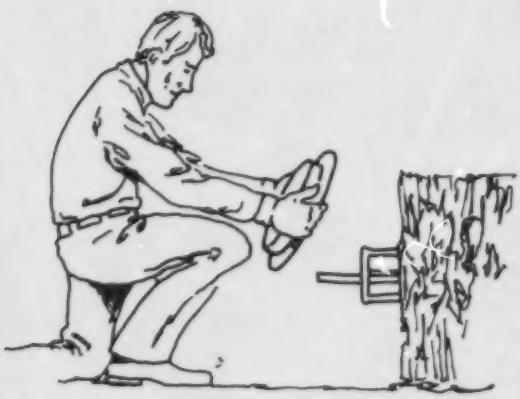
B. Remove brush core from frame

C. Remove bolts from one end of core

D. Remove end flange, or hat (Figure 14)

(NOTE: Remove axle end if unit has a sprocket-driven core.)

FIGURE 14



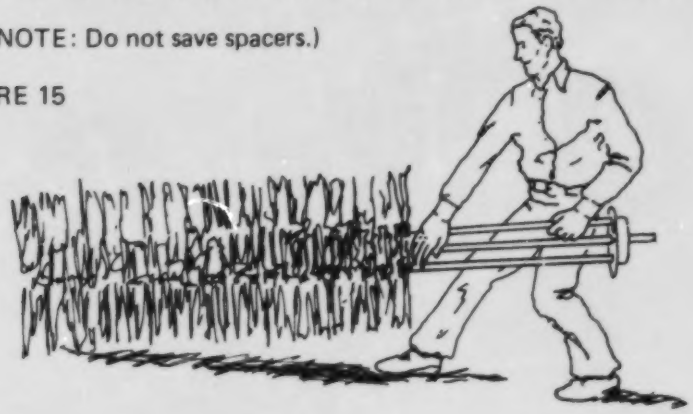
Used with permission of Little Giant Products, Division of Waldon, Inc., Fairview, Oklahoma.

JOB SHEET #7

E. Grasp core at opposite end and slide core out from sections (Figure 15)

(NOTE: Do not save spacers.)

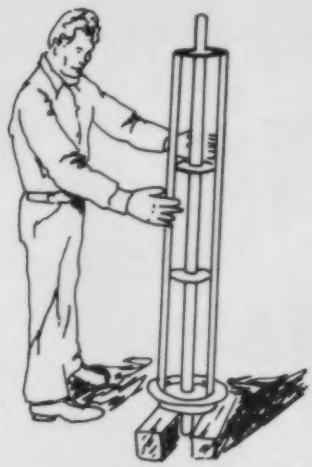
FIGURE 15



Used with permission of Little Giant Products, Division of Waldon, Inc., Fairview, Oklahoma.

F. Insert two blocks under flange and stand core on end (Figure 16)

FIGURE 16



Used with permission of Little Giant Products, Division of Waldon, Inc., Fairview, Oklahoma.

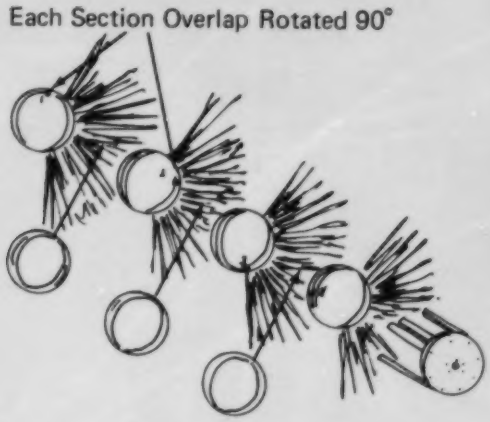
G. Slide crimped wafer, or end wafer, onto core

(NOTE: These end wafers prevent the bristles from getting tangled in the sprocket and chain.)

JOB SHEET #7

H. Locate the "lap" or "lug" (thick part) on the wafers and alternate in a 90-degree rotation (Figure 17)

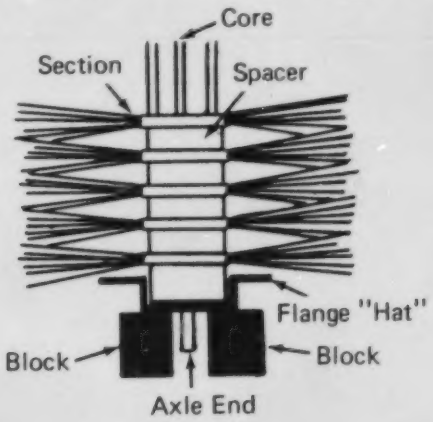
FIGURE 17



Used with permission of Rosco Manufacturing, Minneapolis, Minnesota.

I. Slide wafers and spacers alternately onto core (Figure 18)

FIGURE 18



Used with permission of Rosco Manufacturing, Minneapolis, Minnesota.

J. When wafers and spacers are stacked on core, replace end wafer

K. Reinstall flange and tighten bolts

(NOTE: The last section may be 1/2 to 1 inch short of filling the core, even after bolts are tightened. Sections will later relocate themselves, filling the entire core length.)

L. Reposition core into frame

M. Replace chain and bearing bolts; tighten securely

SWEEPERS
UNIT III

JOB SHEET #8--SWEEP ROADWAY WITH A TOWED SWEEPER

I. Equipment and materials

A. Towed sweeper, either traction powered or engine powered, hitched to pickup or other 1/2-ton to 1-ton truck with hitch

B. Operator's manual

C. Tool box

D. Four 4" x 4" x 18" wood blocks

E. Recommended safety equipment

1. Hard hat
2. Gloves
3. Goggles
4. Respirator
5. Close-fitting clothing

II. Procedure

A. Perform prestart inspection and maintenance procedures

B. Sit in driver's seat and fasten seat belt

C. Start and warm up truck

D. Tow sweeper to job site

E. Stop truck and set emergency brake

F. If using an engine-powered sweeper, start engine and allow it to warm up

G. Set broom height for existing conditions

(NOTE: Broom should be set so that brushes touch the surface lightly and provide the desired sweep pattern.)

H. Set broom angle so that debris will be thrown away from traffic

I. Make sure that all control signs are in place and visible and that warning lights are working

JOB SHEET #8

J. If using engine-powered sweeper, activate broom at rpm suitable to existing conditions

(NOTE: On a traction-powered sweeper, rpm will be determined by the speed of the truck.)

K. Take position in driver's seat and fasten seat belt

L. Release emergency brake

M. Start sweeping from centerline of roadway, moving with traffic

N. Observe where debris is thrown; adjust speed if necessary to keep from interfering with traffic

O. Continue sweeping to end of designated area

P. Make turnaround, merge with traffic, and sweep back to starting point; sweep from centerline, observing where debris is thrown

(NOTE: Use caution when making the turnaround. Allow additional room for the towed sweeper.)

Q. Continue sweeping until designated area has been swept

R. Move sweeper out of traffic lanes

S. Set emergency brake on tow vehicle

T. Release seat belt and dismount carefully

U. If using an engine-powered sweeper, perform shut-down procedures

V. Raise broom to travel position and secure it

W. Return to parking area or yard

X. Tow sweeper to storage area

Y. Park at designated place and block rear wheels

Z. Make final visual inspection for leaks and broken, worn, or missing parts; note deficiencies and then report to proper authority

AA. Unhook sweeper from tow vehicle

BB. Park truck in designated area

SWEEPERS
UNIT III

JOB SHEET #9--SWEEP ROADWAY WITH A SELF-PROPELLED SWEEPER

I. Equipment and materials

A. Self-propelled sweeper

B. Operator's manual

C. Four 4" x 4" x 18" wood blocks

D. Recommended safety equipment

1. Hard hat
2. Gloves
3. Goggles
4. Respirator
5. Close-fitting clothing

II. Procedure

A. Perform prestart inspection and maintenance procedures

B. Mount sweeper using steps and grab irons

C. Sit in operator's seat and fasten seat belt

D. Perform starting and warm-up procedures

E. Manipulate controls to check for proper functioning

F. Raise broom to travel position

G. Release emergency brake

H. Road sweeper to work area

I. Check to make sure that all traffic and warning signs are in place and visible, and that warning lights on sweeper are working properly

J. Set broom angle so that debris will be thrown away from traffic

K. Lower broom until brushes touch surface lightly

(NOTE: Some manufacturer's recommend sweeping with the broom in FLOAT position for normal conditions. Check operator's manual.)

JOB SHEET #9

L. Start in low gear, sweeping from centerline of roadway and moving with traffic

M. Continue sweeping to end of designated area

N. Make turnaround, merge with traffic, and sweep back to starting point; sweep from centerline, observe where debris is thrown

O. Continue sweeping until designated area has been swept

P. Raise broom to travel height

Q. Shift to high gear range and road sweeper to yard, or move sweeper from roadway to a safe and fairly level spot

R. Set emergency brake

S. Shut down sweeper

T. Dismount using steps and grab irons

U. Block rear wheels front and back

V. Make final visual inspection for leaks and broken, worn, or missing parts; note any deficiencies and then report to proper authority

SWEEPERS
UNIT III

TEST

NAME _____ SCORE _____

1. Match terms associated with sweepers to their correct definitions. Write the correct numbers in the blanks.

_____a. Truck or tractor that tows accessory

_____b. Area of ground/broom contact

_____c. Rotation of broom powered by rear wheels of towing vehicle

_____d. Machine that sweeps debris off roadway onto shoulders and into piles or windrows where it can be picked up manually or with a vacuum sweeper

1. Sweeper (power broom)
2. Tow vehicle
3. Traction-powered
4. Sweeping pattern

2. Select from the following list uses of sweepers in highway maintenance. Write an "X" in the blank before each correct answer.

_____a. Cleaning roadways of sand and salt after ice control operations

_____b. Cleaning municipal streets

_____c. Cleaning finish grade for chip seal operations

_____d. Cleaning paved surfaces for chip sealing

_____e. Sweeping away excess chips after chip sealing

_____f. Sweeping potholes for crack sealing

_____g. Sweeping maintenance yard

_____h. Cleaning road surfaces before striping

_____i. Sweeping loose gravel from county roads

_____j. Broom dragging

_____k. Routine grooming of bridges and roadways

_____l. Removing dust and debris from intersections

TEST

3. Identify the parts of a towed sweeper. Write the correct numbers in the blanks.

_____a. Pump release lever

_____b. Brush

_____c. Hitch bar

_____d. Hood

_____e. Frame

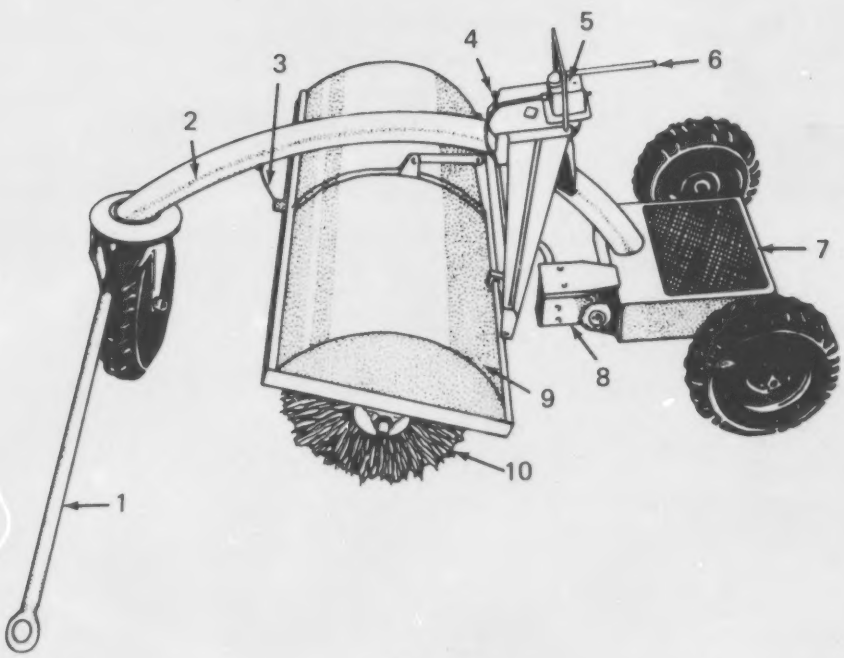
_____f. Lock

_____g. Hydraulic pump

_____h. Platform

_____i. Hydraulic pump lever

_____j. Drive box



TEST

4. Identify the parts of a self-propelled sweeper. Write the correct numbers in the blanks.

_____a. Frame

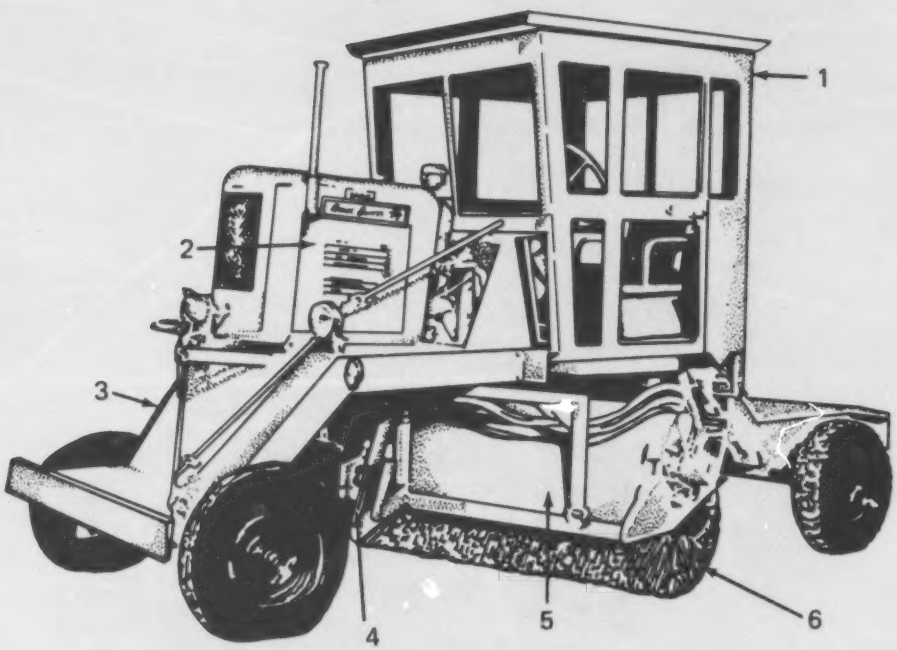
_____b. Dust shield

_____c. Broom

_____d. Engine

_____e. Protective structure (ROPS)

_____f. Lift ram



TEST

5. Identify controls on a typical self-propelled sweeper. Write the correct numbers in the blanks.

_____a. Ignition switch--Starts or stops engine

_____b. Emergency brake--Secures sweeper when sweeper is stopped or parked

_____c. Rotation control--Turns broom on or off

_____d. Temperature gauge--Registers engine operating temperature

_____e. Accelerator--Controls engine speed and forward and reverse movement of sweeper

_____f. Throttle control--Sets constant speed for broom rotation

_____g. Gear shift lever--Selects transmission gear

_____h. Pressure gauge--Registers air pressure

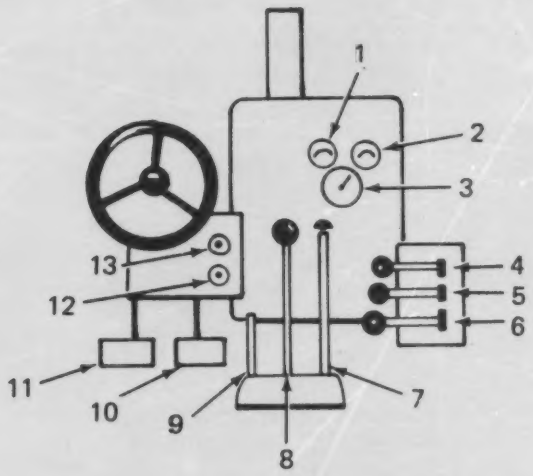
_____i. Broom angle control--Sets broom at a 45-degree angle to right or left

_____j. Range selector--Selects high or low gear range

_____k. Brake--Stops sweeper movement

_____l. Height control--Raises or lowers broom

_____m. Speedometer/hourmeter--Indicates driving speed and hours of operation



TEST

6. State eight safety rules for operating a sweeper.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

   g. _____

   h. _____

7. Match types of brooms to their correct descriptions. Write the correct numbers in the blanks.

   _____a. Continuous bristles that screw into a cable-grooved core

   _____b. Bristle mat fitted to a coil and cable-wrap core with an automatic broom-filling machine

   _____c. Disc that slips onto a metal core

   1. Coil brush
   2. Wafer
   3. Bulk fiber

8. State ten procedures for effective sweeper operation.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

   g. _____

   h. _____

   i. _____

   j. _____

TEST

(NOTE: Test question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Perform prestart inspection and maintenance procedures on a towed sweeper.

   b. Service a towed sweeper.

   c. Perform prestart inspection and maintenance procedures on a self-propelled sweeper.

   d. Service a self-propelled sweeper.

   e. Attach, adjust, tow, operate, and shut down a towed sweeper.

   f. Start, warm up, operate, and shut down a self-propelled sweeper.

   g. Replace wafer bristles.

   h. Sweep roadway with a towed sweeper.

   i. Sweep roadway with a self-propelled sweeper.

SWEEPERS
UNIT III

ANSWERS TO TEST

1. a. 2
   b. 4
   c. 3
   d. 1

2. a, d, e, g, h, j, k

3. a. 4
   b. 10
   c. 1
   d. 9
   e. 2
   f. 3
   g. 5
   h. 7
   i. 6
   j. 8

4. a. 3
   b. 5
   c. 6
   d. 2
   e. 1
   f. 4

5. a. 12
   b. 9
   c. 5
   d. 2
   e. 10
   f. 13
   g. 8
   h. 1
   i. 4
   j. 7
   k. 11
   l. 6
   m. 13

6. Answer should include any eight of the following
   a. Read operator's manual thoroughly: know your machine
   b. Study departmental safety manual
   c. Wear goggles, close-fitting clothing, and respirator

ANSWERS TO TEST

d. Attach and check safety chains

e. Make sure that all personnel and obstructions are cleared from area before operating machine

f. Watch for other equipment in area

g. Use warning lights at all times

h. Use SMV emblem

i. Use grab irons and steps

j. Dismount only after all movement stops

k. Do not leave machine running unattended

l. Use care when sweeping overpasses

m. Keep equipment clean

7. a. 1

b. 3

c. 2

8. Answer should include any ten of the following

a. Perform all required maintenance procedures

b. Gear transmission to regulated ground speed

c. Operate sweeper at full throttle

d. Raise broom completely off ground before transporting

e. Do not allow engine to run for long periods when machine is not in use

f. Operate hydraulic valve handles slowly

g. Use correct broom setting

h. For heavy sweeping, use slower forward speed and increase brush revolutions per minute (rpm)

i. Increase broom setting for problem areas, and then reset immediately

j. Set broom at an angle to sweep curbs

k. Operate at best speed for conditions

ANSWERS TO TEST

l. On two-way highway, start at center and sweep to shoulder

m. On divided highway, start at inside curb and work to outside curb

n. Remove and clean air filter twice daily in extremely dusty conditions

o. Replace brush assembly when worn

p. Clean brush thoroughly after use

9. Performance skills evaluated to the satisfaction of the instructor

CONCRETE SAW
UNIT IV

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order materials to supplement unit.

1. Films

a. *Keep It Concrete.* 16 mm, color, 8 minutes, Ohio Turnpike Commission and Portland Cement Association. This film has been discontinued but may be available on a loan basis from Oklahoma State Department of Transportation, Training Office, 200 N.E. 21st Street, Oklahoma City, Oklahoma 73105, 405/521-4141.

(NOTE: The Ohio Turnpike maintenance crew shows how the turnpike crew repairs concrete, and removes and replaces damaged concrete.)

b. *Resealing Pavement Joints in Minnesota.* 16 mm, color, 7 minutes, Portland Cement Association. This film has also been discontinued, but may be available on a loan basis from Oklahoma State Department of Transportation, Training Office, 200 N.E. 21st Street, Oklahoma City, Oklahoma 73105, 405/521-4141.

(NOTE: The Minnesota Highway Department shows one good method of cleaning and resealing joints and cracks on concrete highways.)

2. Slide sets

a. *Effect of Defective Joint Seals on Pavement Performance.* 21 slides, Portland Cement Association, 1980. Available from PCA, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077, 312/966-6200, ext. 450. Order No. SS280.

(NOTE: This slide program demonstrates the need for installing and maintaining effective sealants in cracks and joints. It illustrates types of distress resulting from joint/seal failures, and reviews methods, equipment, and materials for resealing joints and sealing cracks.)

b. *Utility Patches in Concrete Pavement.* 18 slides, Portland Cement Association, 1980. Available from PCA, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077, 312/966-6200, ext. 450. Order No. SS282.

(NOTE: This slide program shows a step-by-step procedure for making utility cuts in concrete streets and repairing them with concrete. It includes examples of existing patches that have been in service for several years.)

SUGGESTED ACTIVITIES

3. Technical publications

a. *Maintenance of Joints and Cracks in Concrete Pavement.* 10 pages, Portland Cement Association, 1976. Available from PCA, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077, 312/966-6200, ext. 450. Order No. IS188P.

(NOTE: This publication includes methods for resealing joints, sealing cracks, repairing sealed joints, and correcting faulted joints. It presents recommendations for joint resealing materials, patching mixes, and opening sealed/resealed area to traffic.)

b. *Patching Concrete Pavement.* 14 pages, Portland Cement Association, 1976. Available from PCA, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077, 312/966-6200, ext. 450. Order No. IS189P.

(NOTE: This publication describes procedures for patching jointed pavements. It includes full-depth in-place patching, full-depth precast patching, surface patching, and the patching of continuously reinforced concrete pavements.)

B. Provide students with objective sheet.

C. Provide students with information, assignment, and job sheets.

D. Discuss unit and specific objectives.

E. Discuss information and assignment sheets.

F. Demonstrate and discuss procedures outlined in job sheets.

G. Provide alternate jobs if those in job sheets are not practical.

H. Arrange a field trip for students to observe a concrete saw in operation.

I. Introduce students to the basics of concrete mixing and usage.

J. Make or order copies of operator's manual for machine the students will be operating.

K. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Assignment Sheet #1 — Distinguish Between Safe and Unsafe Concrete Saw Operating Procedures

CONCRETE SAW
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a concrete saw safely and effectively. This knowledge will be shown by completing assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with concrete saws to their correct definitions.
2. Select from a list uses of concrete saws in highway maintenance.
3. Identify the parts of a concrete saw and blade assembly.
4. Identify controls on a typical concrete saw.
5. Name types of concrete saw blades.
6. State safety rules for operating a concrete saw.
7. State suggestions for effective concrete saw operation.
8. Distinguish between safe and unsafe concrete saw operating procedures.
9. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a concrete saw.
    b. Service a concrete saw.
    c. Mount blade on a concrete saw.
    d. Hook up water, warm up, start, operate, and shut down a concrete saw.
    e. Cut a bridge deck.
    f. Cut a concrete slab.

SUGGESTED ACTIVITIES

E. Answers to assignment sheet

F. Job sheets

1. Job Sheet #1 — Perform Prestart Inspection and Maintenance Procedures on a Concrete Saw
2. Job Sheet #2 — Service a Concrete Saw
3. Job Sheet #3 — Mount Blade on a Concrete Saw
4. Job Sheet #4 — Hook Up Water, Warm Up, Start, Operate, and Shut Down a Concrete Saw
5. Job Sheet #5 — Cut a Bridge Deck
6. Job Sheet #6 — Cut a Concrete Slab

G. Test

H. Answers to test

III. Unit references

A. *Cimline Deluxe Model Saws.* Minneapolis, Minnesota: Cimline Division, Construction Materials, Inc., n.d.

B. *Cimline Saw Systems, Economy Group.* Minneapolis, Minnesota: Cimline Division, Construction Materials, Inc., 1980.

C. *Operating Instructions for Mid-Range Concrete Saws, Models 140-MR, and 250-MR.* Torrance, California: Felker Operations, Dresser Industries, Inc., n.d.

CONCRETE SAW
UNIT IV

INFORMATION SHEET

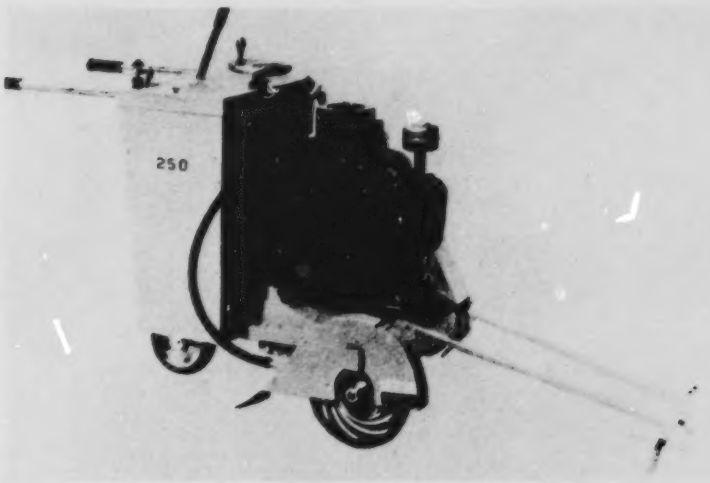
I. Terms and definitions

A. Concrete saw — Engine-powered saw used to cut concrete and asphalt (Figure 1)

(NOTE: Blade can be moved to cut on either side of the saw.)

EXAMPLE:

FIGURE 1



Courtesy of Felker Operations, Division of Dresser Industries, Inc.

B. Arbor shaft — Spindle that holds the revolving saw blade

C. Green concrete — Freshly placed or uncured concrete

D. Crowding — Using excessive force or pressure

E. Cut wet — To use water while operating the saw

F. Longitudinal cut — Cut made along length of concrete slab

G. Transverse cut — Cut made across width of concrete slab

INFORMATION SHEET

H. Carborundum — Silicon carbide cutting material

I. Joint — Space between two sections of concrete

J. Diamond blade — Cutting surface flecked with diamond chips

II. Uses of concrete saws in highway maintenance

A. Cutting old concrete

B. Controlling cracking in green concrete

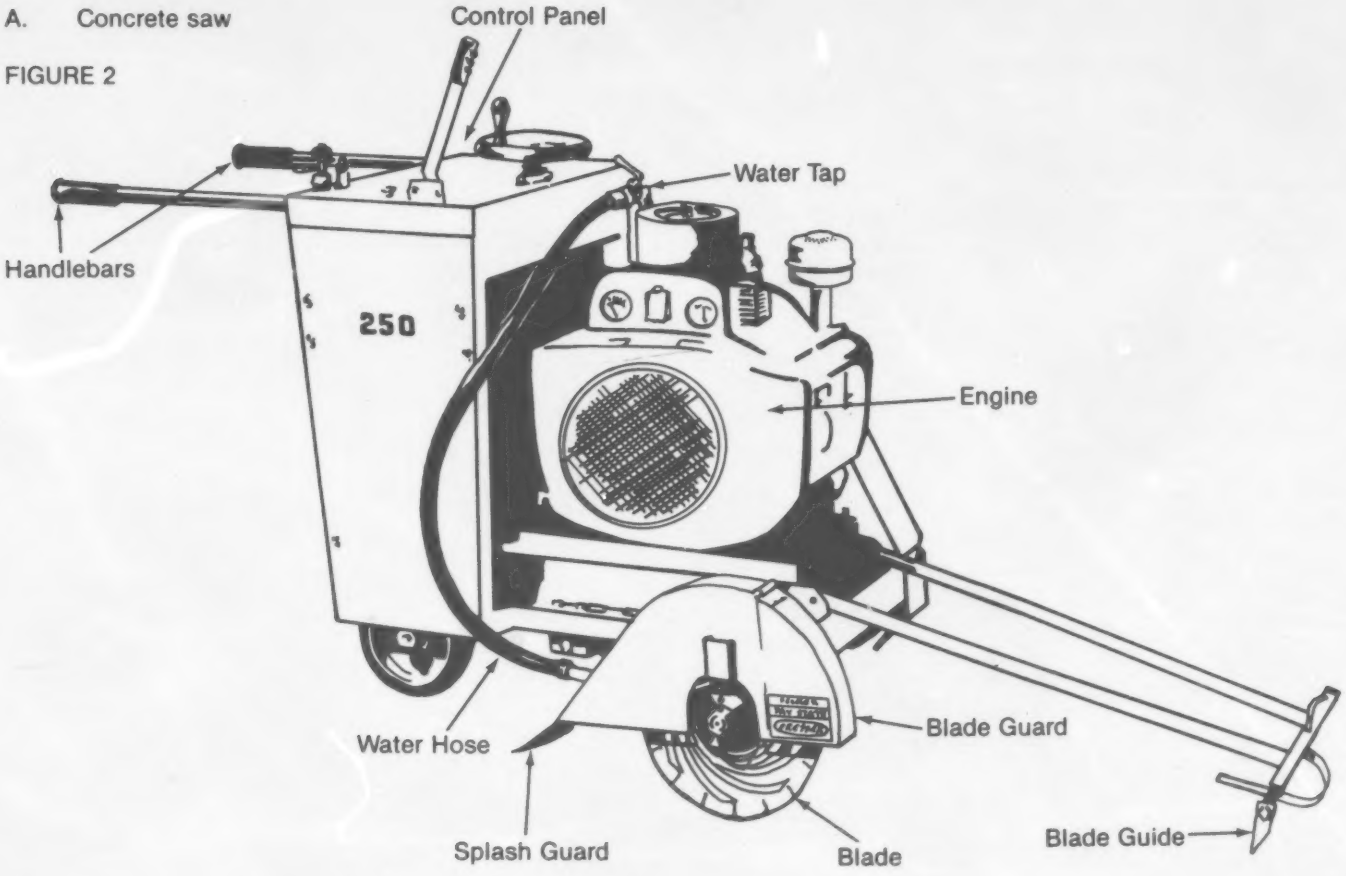
(NOTE: Green concrete will shrink and crack as it settles. Cutting the concrete before it shrinks helps control random cracking. The joints are then filled and sealed with asphalt material.)

C. Cutting old asphalt

III. Parts of a concrete saw and blade assembly (Figures 2 and 3; Job Sheets #1 and #2)

A. Concrete saw

FIGURE 2

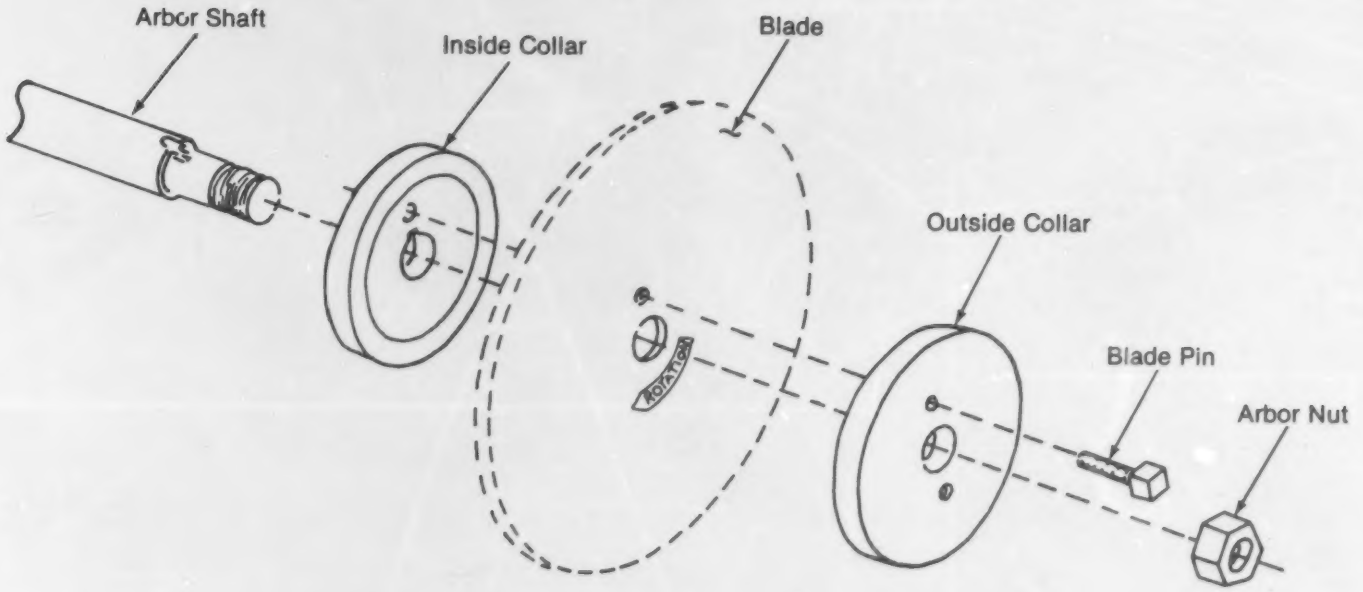


Used with permission of Felker Operations, Division of Dresser Industries, Inc.

INFORMATION SHEET

B. Blade assembly (Job Sheet #3)

FIGURE 3



168

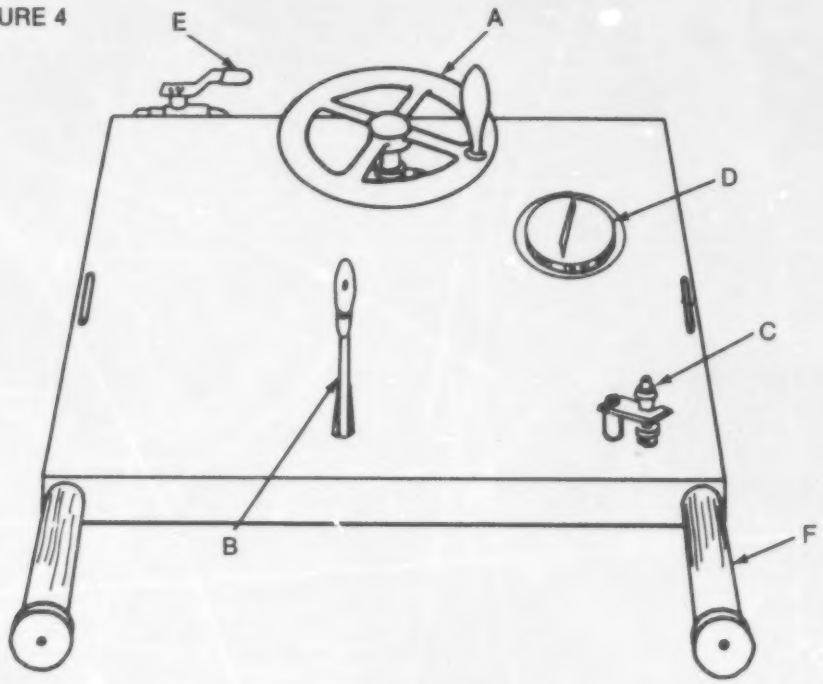
169

INFORMATION SHEET

IV. Controls on a typical concrete saw (Figure 4; Job Sheet #4)

(NOTE: Controls will vary with manufacturer and model.)

FIGURE 4



Used with permission of Felker Operations, Division of Dresser Industries, Inc.

A. Depth control — Lowers or raises blade

(NOTE: Turn clockwise to lower, counterclockwise to raise.)

B. Clutch lever — Starts or stops forward movement

(NOTE: Disengaging the clutch will stop the forward movement of the saw. Pull toward you to engage; push away from you to disengage.)

C. Speed control knob — Controls speed and direction (forward/reverse) of saw unit

D. Gasoline tank filler cap — Covers opening to fuel tank

E. Water valve — Controls water supply

(NOTE: Water valve should be open during cutting operations.)

INFORMATION SHEET

F. Handlebars — Used for holding and guiding the saw

(NOTE: Handle bars slide in for transporting saw and slide out for operating.)

V. Types of concrete saw blades

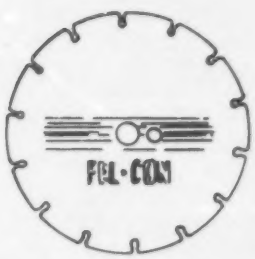
A. Diamond blade

(CAUTION: Cut wet when using a diamond blade.)

B. Abrasive blade

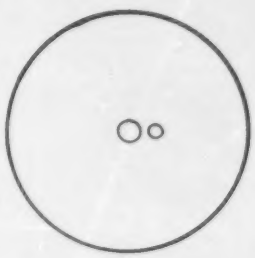
(NOTE: Abrasive blades are made of carborundum, tungsten, or a similar material. They may be operated with or without water. Both types of blades may be segmented or unsegmented. Segmented blades have more cutting power but are more likely to break and cause injury or property damage. See Figures 5 and 6.)

FIGURE 5



Segmented

FIGURE 6



Unsegmented

VI. Safety rules for operating a concrete saw (Assignment Sheet #1)

(NOTE: Improperly used abrasive and diamond blades are dangerous. Know your equipment well; use it properly to avoid accident and injury.)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear recommended protective clothing

EXAMPLES: Safety goggles
Close-fitting clothing
Hard-toed, nonskid shoes

(NOTE: Pavement will be covered with water and grindings and will be slick.)

INFORMATION SHEET

D. Be sure that guards and shields are in place and working properly

E. Keep hands away from moving parts

F. Operate saw only on a level surface

(NOTE: Uneven surfaces can cause the blade to break, possibly causing injury to the operator or other persons in the area.)

G. Inspect blade frequently, particularly when using a segmented blade

(NOTE: Look for undercutting of the steel core. Check for stress cracks in the segments. A segment breaking and flying off can cause injury.)

H. Keep a firm grip on handlebars

I. Keep saw moving only as fast as it is cutting

(NOTE: Do not let the saw move faster than it cuts. It will jump forward and can sprain or dislocate a shoulder.)

J. Never leave saw unattended while engine is running

K. Never stand in path of blade while starting or operating saw

L. Operate saw from between handlebars

M. Do not use excessive force or side pressure

N. Always cut wet when using a diamond blade

O. Be sure that blade is *securely* fastened

VII. Suggestions for effective concrete saw operation (Job Sheets #5 and #6)

A. Perform all prestart inspection and maintenance procedures

B. Be sure that blade is securely fastened to arbor shaft

C. Be sure that water tank is full

(NOTE: If using tank truck or street pressure, hook up water line so that hose bib is on the same side as the water source. Do not trail the hose behind or in front of the saw.)

D. *Before* engaging blade, be sure that water reaches both sides of blade

E. Lower blade into cut *slowly*

F. Keep blade guide on the line

INFORMATION SHEET

G. Cut in a straight line

(NOTE: If cut is not made in a straight line, the blade can overheat and kill the engine.)

H. Let saw propel itself

(NOTE: Do not crowd the blade. Crowding will warp or break the blade.)

I. Inspect blade frequently for damage and wear

J. Cut square when removing concrete for patching

K. When cutting concrete joints, if a crack occurs ahead of saw cut, stop sawing immediately and move saw ahead several joints

(NOTE: Cut the joint ahead, then return and cut the joints between those two cuts.)

L. Drain systems thoroughly for winter storage or if freeze is expected

CONCRETE SAW
UNIT IV

ASSIGNMENT SHEET #1 — DISTINGUISH BETWEEN SAFE AND UNSAFE CONCRETE SAW OPERATING PROCEDURES

NAME _____ SCORE _____

Improper use of a concrete saw can be hazardous to the operator and to other persons in the area. It is *your* responsibility to prevent serious personal injury and property damage.

John is cutting green concrete to control cracking caused by shrinkage and expansion. For each step he takes in his operating procedure, check "safe" or "unsafe." Be prepared to discuss your answers.

		SAFE	UNSAFE
A.	John arrives at work wearing hard-toed, rubber-soled boots	_____	_____
B.	He wears his shirttail outside his pants	_____	_____
C.	He checks the saw thoroughly before operating it	_____	_____
D.	He starts the engine, and then lowers the blade guard	_____	_____
E.	After the engine warms up, he stands between the handlebars and lowers the blade to cutting level by turning the crank	_____	_____
F.	He checks the water line to make sure that it is properly connected	_____	_____
G.	John stands beside the saw; gripping the right handlebar with his right hand, he engages the clutch with his left hand and moves to his position between the handlebars	_____	_____
H.	He turns the water on as the saw begins its forward movement	_____	_____
I.	He lets the saw propel itself forward without pushing it	_____	_____
J.	As the saw moves to the left, he forces the blade back to the right	_____	_____
K.	He lights and smokes a cigarette while he is cutting	_____	_____
L.	On his breaks, he checks the blade for damage and wear before returning to work	_____	_____
M.	His supervisor signals him to stop to answer a question; John puts the clutch in neutral, raises the blade and goes over to the supervisor	_____	_____
N.	When he returns to finish the operation, it is nearly quitting time; John decides to increase his productivity by moving the saw faster	_____	_____

ASSIGNMENT SHEET #1

		SAFE	UNSAFE
O.	When he finishes the job, he shuts down the machine	_____	_____
P.	He secures the saw for the night and goes home	_____	_____

Q. Are there any procedures that John neglected to perform? If so, what are they and when should they have been performed?

_____

_____

_____

_____

_____

_____

CONCRETE SAW
UNIT IV

ANSWERS TO ASSIGNMENT SHEETS

A. Safe

B. Unsafe — John should wear close-fitting clothing

C. Safe

D. Unsafe — He should lower the guard *before* starting the engine

E. Safe

F. Safe

G. Unsafe — He should operate the saw from between the handlebars

H. Unsafe — Water should be turned on *before* starting the saw so that the blade does not overheat

I. Safe

J. Unsafe — He should not use excessive force or side pressure

K. Unsafe — He must let go of the handlebars to smoke; it is unsafe to have sparks and flame near gasoline-powered equipment

L. Safe

M. Unsafe — He should not leave the engine running unattended

N. Unsafe — He should let the saw propel itself and not force it

O. Safe

P. Safe

Q.
1. He did not put on safety goggles before starting machine
2. He did not make a final walk-around visual inspection for leaks and broken, worn, or missing parts
3. He did not return tools and equipment to their proper places

CONCRETE SAW
UNIT IV

JOB SHEET #1 — PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A CONCRETE SAW

I. Equipment and materials

A. Concrete saw

B. Operator's manual

C. Engine oil

D. Engine coolant

E. Fuel

F. Lubricants

G. Grease gun

H. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level; add engine oil if needed

C. Check engine coolant level; add coolant if needed

D. Check fuel level; fill tank if necessary

E. Check battery connections for tightness and corrosion

F. Check battery electrolyte level; add water if needed

G. Check air cleaner; remove and clean filter if necessary

H. Clean and lubricate all grease fittings according to operator's manual

I. Check belts for proper tension

(NOTE: See operator's manual for amount of flex.)

J. Check gauges

JOB SHEET #1

K. Check levers and controls for proper functioning

L. Check safety devices: guards and shields

M. Check major components

1. Water lines
2. Arbor nut for tightness
3. Condition of blade

CONCRETE SAW
UNIT IV

JOB SHEET #2 — SERVICE A CONCRETE SAW

I. Equipment and materials

A. Concrete saw

B. Operator's manual

C. Tool kit

D. Grease gun

E. Lubricants

F. Cleaning solvents

G. Rags

H. Water

I. Engine oil

J. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

C. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

D. Clean air filter; replace if necessary

E. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

JOB SHEET #2

F. Check exhaust system for loose connections and holes

G. Check clutch adjustment; adjust if necessary

H. Check drive belts for tension and wear; adjust or replace if necessary

I. Check wiring, insulation, and connections

J. Lightly oil control cables

EXAMPLES: Speed cable, choke cable, throttle cable

K. Clean and lubricate all grease fittings according to operator's manual

L. Check all safety devices; repair if necessary

M. Check blade shaft and drive pin for wear

N. Check blade for wear; replace if necessary

(NOTE: Always clean the collar when changing blades.)

O. Check blade guide alignment; adjust if necessary

(NOTE: See operator's manual for alignment and adjustment procedures.)

CONCRETE SAW
UNIT IV

JOB SHEET #3 — MOUNT BLADE ON A CONCRETE SAW

I. Equipment and materials

A. Concrete saw

B. Operator's manual

C. Blade

D. Wrench

E. Solvent

F. Rags

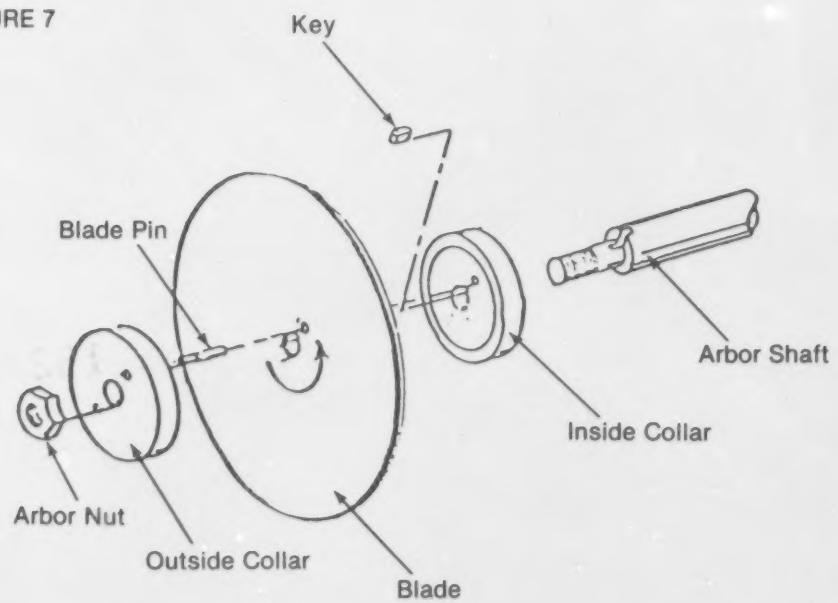
II. Procedure

A. Turn crank wheel counterclockwise to raise machine until arbor is well above blade height

B. Remove blade guard by lifting it completely off machine

C. Use wrench to remove arbor nut and outer collar from shaft (Figure 7)

FIGURE 7



JOB SHEET #3

D. Clean blade collars and arbor shaft

E. Mount blade on arbor shaft and align pin holes

(NOTE: Be sure blade is mounted so that it will turn in the direction indicated by the arrow.)

F. Reinstall outside collar and secure tightly with arbor nut

(CAUTION: Arbor nut must be firmly secured.)

G. Reinstall blade guard

CONCRETE SAW
UNIT IV

JOB SHEET #4 — HOOK UP WATER, WARM UP, START, OPERATE, AND SHUT DOWN A CONCRETE SAW

I. Equipment and materials

- A. Concrete saw
- B. Operator's manual
- C. Diamond blade mounted on saw
- D. Concrete practice area
- E. Chalk line
- F. Clear lacquer
- G. Recommended safety equipment
  1. Hard hat
  2. Safety goggles
  3. Close-fitting clothing
  4. Hard-toed, nonskid shoes
  5. Respirator

II. Procedure

- A. Perform prestart inspection and maintenance procedures
- B. Remove blade guard
- C. Hook up water hose
- D. Turn water valve to ON position and visually inspect water ports

  (NOTE: Water should flow through each port on both sides of blade.)
- E. Turn water valve to OFF position
- F. Reinstall blade guard
- G. Snap chalk line on pavement; spray with clear lacquer to prevent it from washing away

JOB SHEET #4

H. Be sure blade is raised off ground

I. Turn blade safety switch to OFF position

(NOTE: Blade safety switch will stop the engine if the water pressure gets low.)

J. Start engine; allow to warm up three to five minutes

1. Pull choke out about two-thirds of the way
2. Start engine
3. Open throttle slightly when starting; allow engine to warm up
4. Push choke all the way in as engine warms up

K. Pull throttle to full open position

(NOTE: Governor will maintain blade speed during operation.)

L. Position saw blade and guide directly over cutting line

M. Turn water valve to ON position

(NOTE: Check to be sure that water is reaching both sides of blade.)

N. Turn crank wheel clockwise to lower machine until bottom edge of blade is just at pavement level

(NOTE: Notice the position of the crank wheel.)

O. Set blade depth according to manufacturer's instructions

P. Engage clutch

Q. Adjust speed to maximum cutting speed

R. Cut a length of concrete

1. Keep blade guide on line
2. Cut in a straight line
3. Let saw propel itself
4. Do not crowd or force blade in any way
5. Keep a firm grip on handlebars

JOB SHEET #4

S. Return clutch lever to NEUTRAL position

T. Turn crank counterclockwise to raise blade out of pavement

U. Turn water valve to OFF position

V. Shut down engine

CONCRETE SAW
UNIT IV

JOB SHEET #5 — CUT A BRIDGE DECK

I. Equipment and materials

A. Concrete saw with abrasive blade

B. Operator's manual

C. Tool box

D. Recommended safety equipment

1. Hard hat

2. Hard-toed, nonskid shoes

3. Gloves

4. Safety goggles

5. Close-fitting clothing

II. Procedure

A. Perform prestart inspection and maintenance procedures

B. Load saw

C. Transport saw to job site

D. Post required traffic control and warning signs

E. Unload saw at location where work is to be done

F. Visually check saw and correct any minor deficiencies found

G. Position saw so that blade is directly over where cut is to be made, 4 to 6 inches outside the repair

H. Perform start and warm up procedures

I. Lower blade slowly with screw feed until desired depth is reached, 1/4 inch above top of steel

(CAUTION: Do not cut into steel.)

J. Shift saw into forward gear

JOB SHEET #5

K. Complete cut on one side of repair

L. Shift gear lever to NEUTRAL position

M. Raise blade with screw feed until it clears pavement

N. Position saw on an adjacent side for next cut

O. Repeat steps H through M

P. Continue cutting until all four sides are sawed

Q. Shift gear lever to NEUTRAL position

R. Raise blade about 2 inches above pavement

S. Perform shut-down procedure

T. Load concrete saw

U. Move to next job or return to yard

CONCRETE SAW
UNIT IV

JOB SHEET #6 — CUT A CONCRETE SLAB

I. Equipment and materials

A. Concrete saw with correct diamond blade

(NOTE: Diamond blades are manufactured for different grades or hardnesses of concrete and are designated either by number or color. Be sure to select the correct saw for the condition of the concrete.)

B. Water supply

(NOTE: Use water truck, [250 gallon minimum] or carry saw on trailer with water tanks mounted on it.)

C. Operator's manual

D. Chalk line and clear lacquer

E. Tool box

F. Safety equipment

1. Hard hat
2. Hard-toed, nonskid shoes
3. Gloves
4. Safety goggles
5. Close-fitting clothing

II. Procedure

A. Perform prestart inspection and maintenance procedures

B. Transport saw to job site

C. Post required traffic control and warning signs

D. Unload saw

(NOTE: If unloading from a trailer, start saw engine, place in reverse gear, and back saw down ramp or boards.)

E. Snap chalk line along cutting line and spray chalk mark with clear lacquer

JOB SHEET #6

F. Line up saw with chalk line

G. Connect water hose from water supply to pump on saw

H. Perform starting procedure

I. Start water pump

J. Make sure water is flowing to both sides of blade

K. Lower blade slowly with screw feed until desired depth is reached

L. Put saw in forward gear; cut, keeping guide pointer on cutting line

(NOTE: Make a straight cut. Be prepared at all times to put the gear lever in NEUTRAL and to raise the blade if the engine lugs. If this happens, allow engine to reach normal operating speed, lower blade to cutting depth, and continue sawing.)

M. Saw to end of section

N. Shift to NEUTRAL and shut off water pump

O. Raise blade with screw feed until it is 1 to 2 inches above pavement

P. Move saw and line it up with end cut

Q. Repeat sawing procedure until each side has been cut

R. Shift to NEUTRAL and raise saw blade above surface

S. Shut off water and disconnect water supply hose

T. Shut down saw

(NOTE: If loading into trailer, leave engine on, shift to forward gear, and move to loading ramp. Load saw and shut it down; secure to truck or trailer.)

U. Put all equipment in its proper place; secure as needed for travel

CONCRETE SAW
UNIT IV

TEST

NAME _____ SCORE _____

1. Match terms associated with concrete saws to their correct definitions. Write the correct numbers in the blanks.

_____a.	Using excessive force or pressure	1. Arbor shaft
_____b.	To use water while operating the saw	2. Longitudinal cut
_____c.	Engine-powered saw used to cut concrete and asphalt	3. Carborundum
_____d.	Silicon carbide cutting material	4. Concrete saw
_____e.	Spindle that holds the revolving saw blade	5. Green concrete
_____f.	Freshly placed or uncured concrete	6. Transverse cut
_____g.	Cut made across width of concrete slab	7. Cut wet
_____h.	Cutting surface flecked with diamond chips	8. Joint
_____i.	Space between two sections of concrete	9. Diamond blade
_____j.	Cut made along length of concrete slab	10. Crowding

2. Select from the following list uses of concrete saws in highway maintenance. Write an "X" in the blank before each correct answer.

_____a. Cutting old asphalt

_____b. Controlling shrinkage in green concrete

_____c. Cutting concrete forms

_____d. Cutting old concrete

_____e. Controlling cracking in green concrete

_____f. Controlling cracking in old concrete

_____g. Cutting concrete beams

TEST

3. Identify the parts of a concrete saw and blade assembly. Write the correct numbers in the blanks.

Concrete saw

_____a. Engine

_____b. Blade

_____c. Water hose

_____d. Blade guide

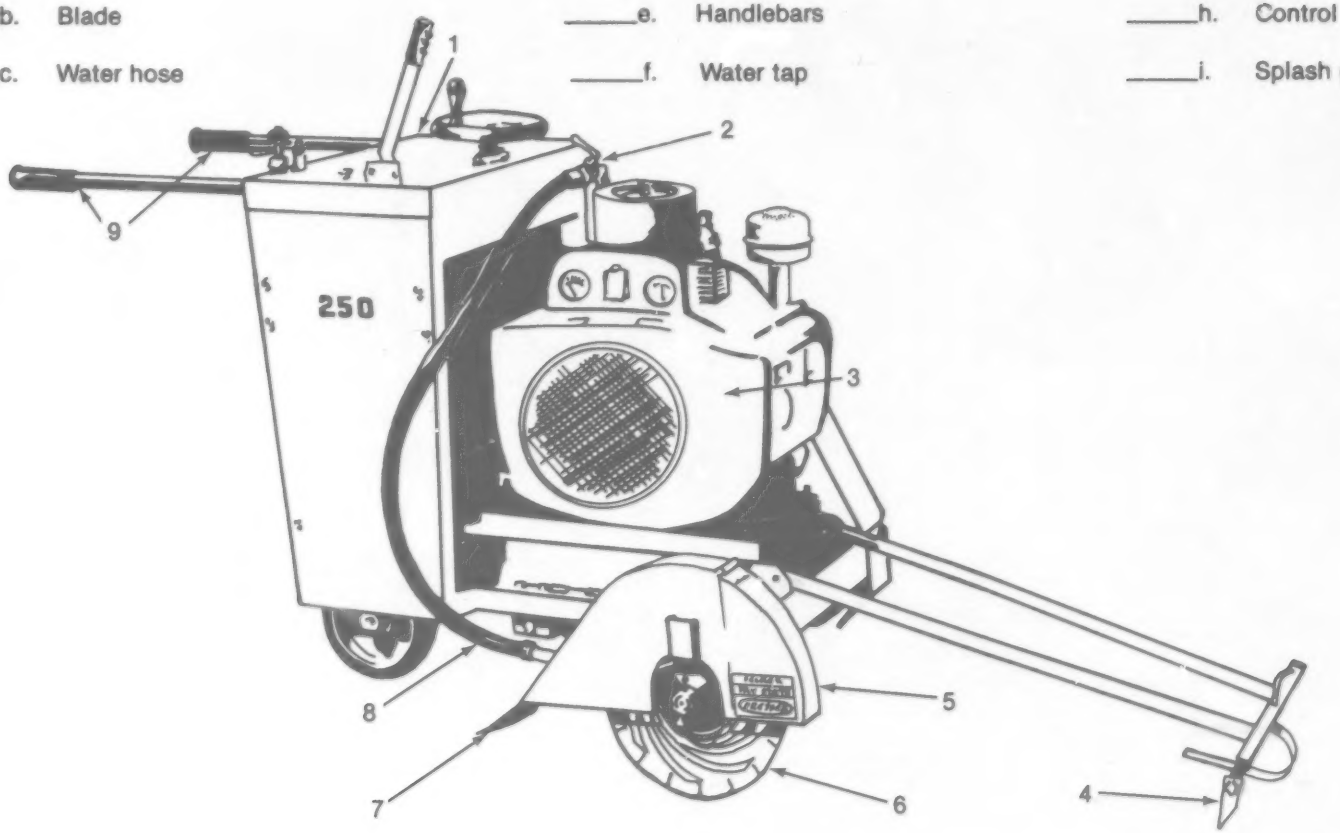
_____e. Handlebars

_____f. Water tap

_____g. Blade guard

_____h. Control panel

_____i. Splash guard



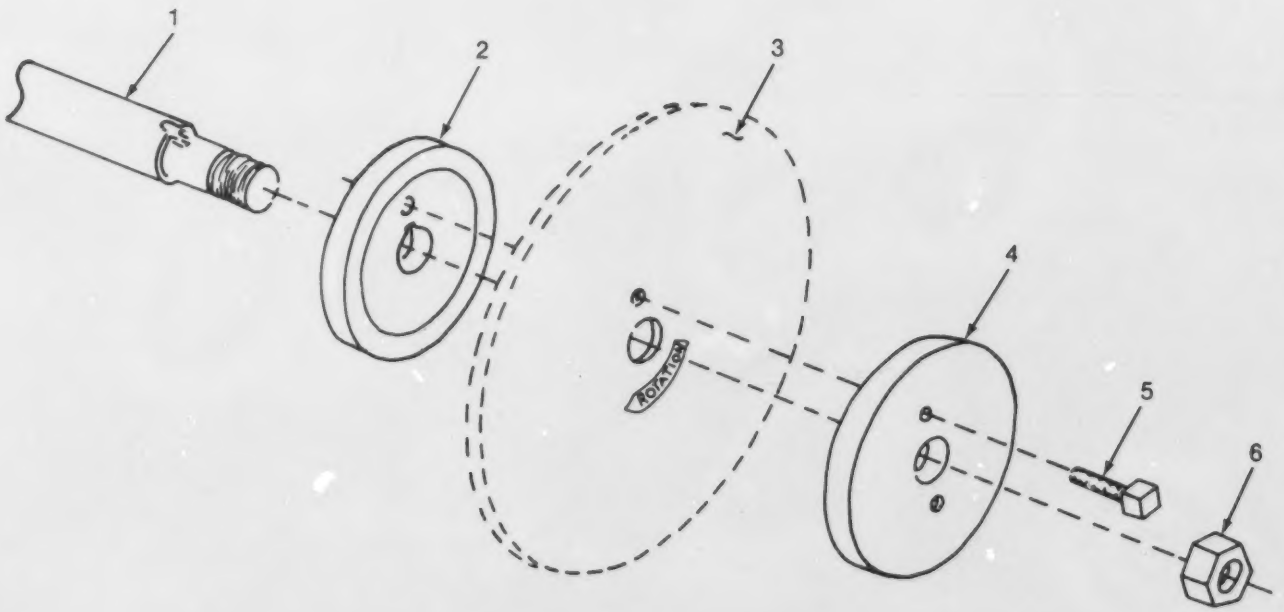
TEST

Blade assembly

_____a. Outside collar _____d. Arbor shaft

_____b. Arbor nut _____e. Blade pin

_____c. Blade _____f. Inside collar



193

194

TEST

4. Identify controls on a typical concrete saw. Write the correct numbers in the blanks.

_____a. Water valve — Controls water supply

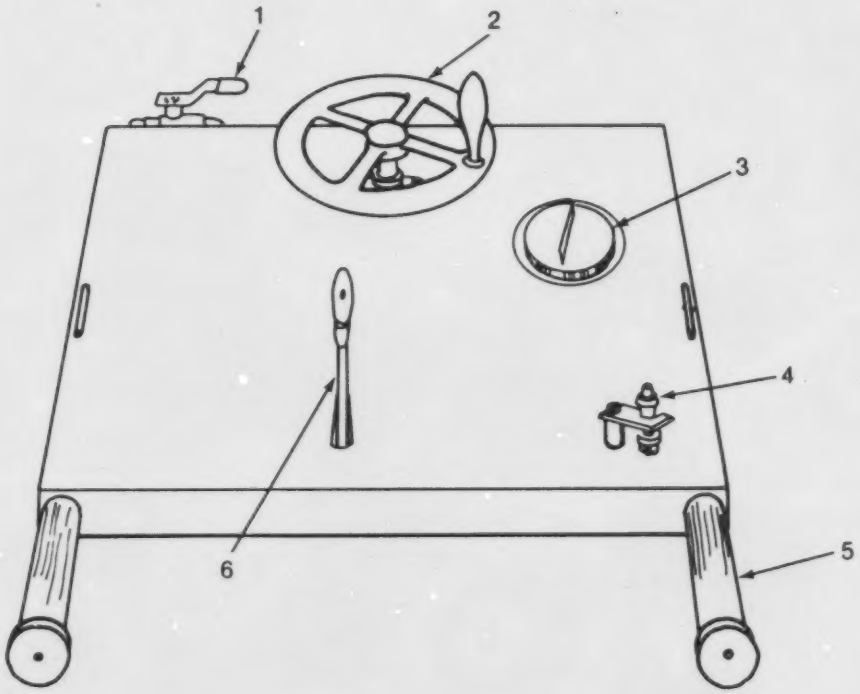
_____b. Clutch lever — Starts or stops forward movement

_____c. Handlebars — Used for holding and guiding the saw

_____d. Gasoline tank filler cap — Covers opening to fuel tank

_____e. Depth control — Lowers or raises blade

_____f. Speed control knob — Controls speed and direction (forward/reverse) of saw unit



5. Name types of concrete saw blades.

a. _____

b. _____

TEST

6. State ten safety rules for operating a concrete saw.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

j. _____

7. State eight suggestions for effective concrete saw operation.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

(NOTE: Test questions 8 and 9 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Distinguish between safe and unsafe concrete saw operating procedures.

TEST

9. Demonstrate the ability to

   a. Perform prestart inspection and maintenance procedures on a concrete saw.

   b. Service a concrete saw.

   c. Mount blade on a concrete saw.

   d. Hook up water, warm up, start, operate, and shut down a concrete saw.

   e. Cut a bridge deck

   f. Cut a concrete slab.

CONCRETE SAW
UNIT IV

ANSWERS TO TEST

1.

a.	10	f.	5
b.	7	g.	6
c.	4	h.	9
d.	3	i.	8
e.	1	j.	2

2. a, d, e

3. **Concrete saw**

a.	3	f.	2
b.	6	g.	5
c.	8	h.	1
d.	4	i.	7
e.	9		

Blade assembly

a.	4	d.	1
b.	6	e.	5
c.	3	f.	2

4.

a.	1	d.	3
b.	6	e.	2
c.	5	f.	4

5. a. Diamond blade

b. Abrasive blade

ANSWERS TO TEST

6. Answer should include any ten of the following

   a. Read operator's manual thoroughly: know your machine

   b. Study departmental safety manual

   c. Wear recommended protective clothing

   d. Be sure that guards and shields are in place and working properly

   e. Keep hands away from moving parts

   f. Operate saw only on a level surface

   g. Inspect blade frequently, particularly when using a segmented blade

   h. Keep a firm grip on handlebars

   i. Keep saw moving only as fast as it is cutting

   j. Never leave saw unattended while engine is running

   k. Never stand in path of blade while starting or operating saw

   l. Operate saw from between handlebars

   m. Do not use excessive force or side pressure

   n. Always cut wet when using a diamond blade

   o. Be sure that blade is *securely* fastened

7. Answer should include any eight of the following

   a. Perform all prestart inspection and maintenance procedures

   b. Be sure that blade is securely fastened to arbor shaft

   c. Be sure that water tank is full

   d. *Before* engaging blade, be sure that water reaches both sides of blade

   e. Lower blade into cut *slowly*

   f. Keep blade guide on the line

   g. Cut in a straight line

   h. Let saw propel itself

ANSWERS TO TEST

i. Inspect blade frequentiy for damage and wear

j. Cut square when removing concrete for patching

k. When cutting concrete joints, if a crack occurs ahead of saw cut, stop sawing immediately and move saw ahead several joints

l. Drain systems thoroughly for winter storage or if freeze is expected

8. Evaluated to the satisfaction of the instructor

9. Performance skills evaluated to the satisfaction of the instructor

SPRAY EQUIPMENT
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to operate spray equipment safely and effectively. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with spray equipment to their correct definitions.
2. Match types of sprayers to their correct descriptions/uses.
3. Identify the parts of a sprayer.
4. Match the parts of a sprayer to their correct functions.
5. State safety rules for operating spray equipment.
6. Select from a list factors that affect application rate.
7. Select from a list procedures for effective sprayer operation.
8. Demonstrate the ability to
   a. Perform prestart inspection and maintenance procedures on a sprayer.
   b. Clean a sprayer.
   c. Spray for weed control.

SPRAY EQUIPMENT
UNIT V

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order materials to supplement unit.

1. Film — *Emergency Overdose.* 16 mm, color, 17 minutes, Cambridge Book Company, 1978. Available from Cambridge Book Company, Inc., Division of the New York Times Company, 488 Madison Avenue, New York, New York 10022.

(NOTE: Instruction is given in handling overdose victims: checking for openness of airways, breathing, blood pressure, and level of consciousness.)

2. Video-cassette presentations

a. *Man the Spray Rig.* Color, 14 minutes, Oklahoma State University Extension, 1979. Available from Oklahoma Department of Transportation, 200 Northeast 21st Street, Oklahoma City, Oklahoma 73105, 405/521-4141. Order Number 425-79-1-2.

(NOTE: Instructional program illustrates basic calibrating, mixing and spraying procedures for chemical weed control programs. The boom and boomless spray rig are shown as well as their component parts. Use of the nomograph is included.)

b. *Chemical Control: Keep the Right-of-Way.* Color, 12 minutes, Oklahoma State University Extension. Available from Oklahoma Department of Transportation, 200 Northeast 21st Street, Oklahoma City, Oklahoma 73105, 405/521-4141. Order Number 425-79-1-3.

(NOTE: Instructional program outlines chemical applications for weed control. Plant types and herbicides are categorized, describing how specific chemicals should be used on specific plant species. Safety precautions are included.)

c. *Johnson Grass.* Color, 11:44 minutes, Oklahoma State University Extension, 1979. Available from Oklahoma Department of Transportation, 200 Northeast 21st Street, Oklahoma City, Oklahoma 73105, 405/521-4141, Order Number 425-79-1-4.

(NOTE: Instructional program introduces the viewer to Johnson grass and how it affects roadside safety and beauty along highways in Oklahoma. The plant's characteristics are discussed as well as the special chemicals and methods used to control it.)

SUGGESTED ACTIVITIES

B. Make transparency.

C. Provide students with objective sheet.

D. Provide students with information and job sheets.

E. Discuss unit and specific objectives.

F. Discuss information sheet.

G. Demonstrate and discuss procedures outlined in job sheets.

H. Invite a resource person to speak on applicator certification in your state.

I. Arrange a field trip for students to observe spraying operations.

J. Identify weeds common to your area and make pictures or transparencies of them available to students.

K. Stress safe handling of herbicides.

(NOTE: This unit does not include information on specific herbicides and their applications because many state departments of transportation require operators to attend an applicator certification workshop.)

L. Check your state department of transportation safety manual for information on handling spills and herbicides.

M. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency master: TM #1 — Sprayer Nozzle

E. Job Sheets

1. Job Sheet #1 — Perform Prestart Inspection and Maintenance Procedures on a Sprayer

2. Job Sheet #2 — Clean a Sprayer

3. Job Sheet #3 — Spray for Weed Control

F. Test

G. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. *Fundamentals of Service: Mowing and Spraying Equipment.* Moline, Illinois: Deere & Company, 1971.

B. Huffine, Wayne, and Lonnie Cargill. *Timely Tips.* Oklahoma City, Oklahoma: Oklahoma Department of Transportation (R & D Division), December, 1980.

C. *Power Sprayer Guide.* Dakota City, Nebraska: The Broyhill Company, 1982.

SPRAY EQUIPMENT
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. Sprayer — Machine for controlled delivery of solutions; operates hydraulically

(NOTE: Sprayer may be mounted on a truck or towed behind a truck or tractor.)

B. Atomization — Liquid breakup caused by the tearing action of air

(NOTE: As the liquid shoots from the nozzle, it is in unstable sheets or jets, which collapse into tiny droplets.)

C. psi — Pounds per square inch; a standard measure of pressure

D. Herbicide — Chemical used for controlling undesirable plants

E. Weed control — Eradicating weeds and leaving desirable plants along the highway right-of-way

F. Dispersal rate — Amount of material sprayed per unit of time; ounces per minute

G. Boom — Mechanical structure used to extend and carry nozzles for a sprayer carrier

H. Spray gun — Hand-held nozzle

I. Agitation — Process of stirring or mixing

J. Target area — Area to be treated

K. Drift — Herbicide droplets blowing away from target area

L. Application rate — Amount of material sprayed; expressed in gallons per acre (gpa) or pounds per acre, depending on herbicides used

INFORMATION SHEET

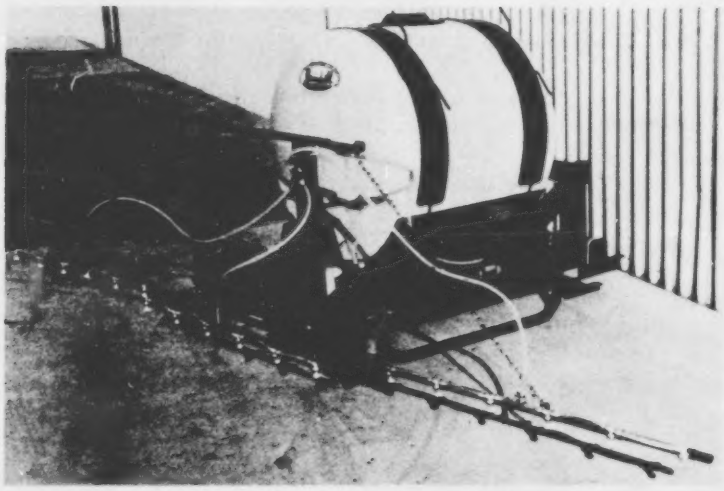
II. Descriptions/uses of types of sprayers

A. Boom — A bar equipped with several flat-fan nozzles; used for spraying large areas (Figure 1)

(NOTE: Truck or tractor drives over target area; dispersal rate is determined by speed.)

EXAMPLE:

FIGURE 1



Courtesy of The Broyhill Company, Dakota City, Nebraska.

B. Boomless — An off-center flooding nozzle on the side of the rig disperses the herbicide in an arc pattern; used for spraying in rough terrain or around signs and guard rails (Figure 2)

(NOTE: Speed determines dispersal rate. Drift may carry herbicide into cab.)

EXAMPLE:

FIGURE 2

206

Courtesy of Oklahoma State University Extension Service.

INFORMATION SHEET

C. Spray gun — Operator walks alongside truck and directs hand-held nozzle; used for medians and spot spraying (Figure 3)

(NOTE: Dispersai rate is determined by length of time the operator sprays the target area.)

EXAMPLE:

FIGURE 3

Courtesy of The Broyhill Company, Dakota City, Nebraska.

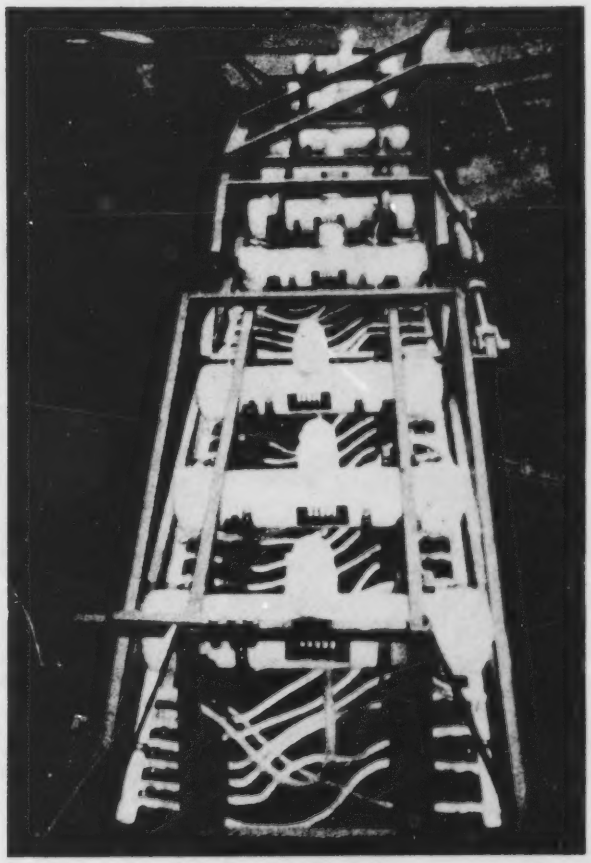
INFORMATION SHEET

D. Rope or wick — Ropes are soaked with herbicide, then driven over the target area, spreading herbicide on leaves; used for Johnson grass and tall weeds (Figure 4)

(NOTE: Herbicide is poured into the tanks, then gravity-fed into a series of manifolds and soaked up by nylon ropes. The height of the ropes is adjusted hydraulically from the cab.)

EXAMPLE:

FIGURE 4



208

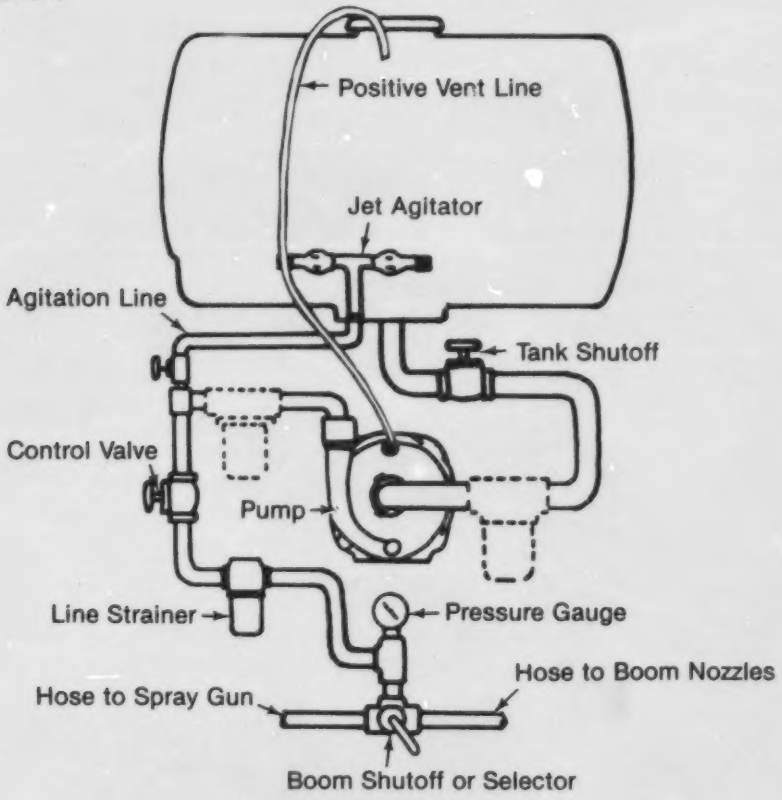
Courtesy of Oklahoma State University Extension Service.

INFORMATION SHEET

III. Parts of a sprayer (Figure 5; Job Sheet #1)

(NOTE: The figure below is a centrifugal pump system.)

FIGURE 5



Adapted with permission of The Broyhill Company, Dakota City, Nebraska.

IV. Sprayer parts and their functions

A. Tank — Holds from 300 to 1,500 gallons or more

B. Pump — Delivers liquid at a constant pressure over long periods of time

(NOTE: Pump is operated by hydraulic pressure, power take-off, or small engine.)

INFORMATION SHEET

C. Pressure regulator — Maintains constant pressure

(NOTE: The pressure regulator can be adjusted to raise or lower pressure in the system.)

D. Pressure gauge — Measures discharge rate

(NOTE: The gauge should be sensitive enough to register pressure in the range of 20 to 40 pounds per square inch.)

E. Hoses — Transport herbicide to nozzles

F. Agitator — Mixes herbicide and a liquid

(NOTE: The agitator consists either of a propeller or a series of paddles on a shaft that runs horizontally through the tank.)

G. Strainers — Prevent foreign materials from plugging lines

(NOTE: There are two strainers: a suction line strainer located inside the tank, and an in-line strainer on the outside.)

H. Nozzle — Meters herbicide at a certain flow rate, atomizes the liquid into droplets, disperses the droplets in a specific pattern, and propels them for proper impact (Transparency #1)

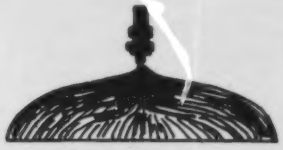
(NOTE: Two types of nozzles are commonly used for weed control: a flat-fan spray nozzle and a flood spray nozzle. See Figures 6 and 7.)

EXAMPLES:

FIGURE 6

Flat-Fan Spray

FIGURE 7



Flood Spray

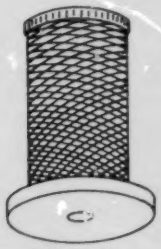
Used with permission of Deere & Company, Moline, Illinois

INFORMATION SHEET

I. Screen — Keeps foreign material from clogging the spray tip; located inside each nozzle (Figure 8)

EXAMPLE:

FIGURE 8



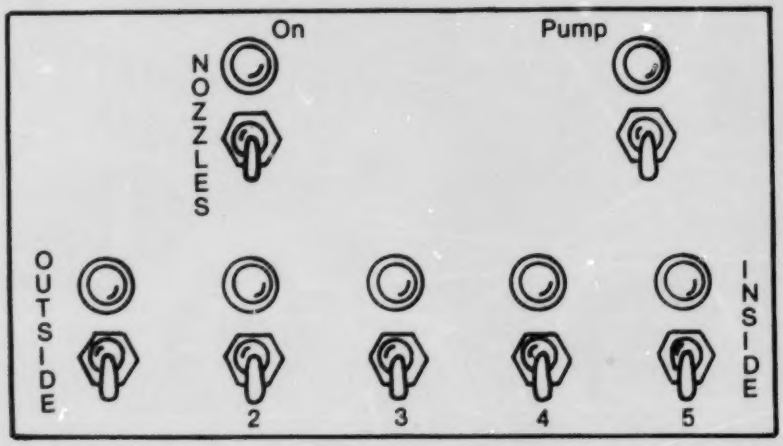
Screen

Used with permission of Deere & Company, Moline, Illinois.

J. Control panel — Controls boom and nozzle functions; mounted in truck cab (Figure 9)

EXAMPLE:

FIGURE 9



Courtesy of Oklahoma State University

INFORMATION SHEET

V. Safety rules for operating spray equipment

(NOTE: The first rule of safe operation is to know the capabilities and limitations of your equipment.)

A. Before operating equipment, attend program on handling herbicides

B. Read operator's manual thoroughly: know your machine

C. Study departmental safety manual

D. Wear protective clothing and equipment

EXAMPLES: Hard hat; goggles; respirator; waterproof gloves, clothing, and boots

(NOTE: Pull pa.. legs down on *outside* of boots.)

E. Read herbicide label directions

F. Carry label or a copy of label in truck to job site

G. Avoid contact with spray

H. Keep windows closed

I. Turn sprayer off when not spraying

EXAMPLES: When turning truck around, changing spray locations, making adjustments

J. Wash off immediately any herbicide that comes in contact with your skin

(NOTE: Carry soap and water on truck.)

K. Do not spray on windy days

L. Take care that drift does not get on operator, on private property, or on areas used by the public

(NOTE: Use common sense. Shut down sprayer when there is danger of exposure to drift.)

M. Keep persons, pets, and livestock away from spray area

N. Use all required traffic control devices 212

O. Wash hands thoroughly before eating

INFORMATION SHEET

P. Wash clothes worn for a spraying operation before wearing them again

Q. Do not clean spraying equipment or dump excess spray materials near lakes, streams, or ponds

VI. Factors that affect application rate

(NOTE: Use common sense. Adjust factors to maintain a constant application rate as conditions require.)

A. Speed

B. Nozzle pressure

C. Terrain

D. Wind speed and direction

E. Location of spray rig in relation to target area

VII. Procedures for effective sprayer operation (Job Sheets #2 and #3)

A. Perform all prestart inspection and maintenance procedures

B. Apply herbicide at given application rate

C. Spray as conditions require

(NOTE: Some areas will require thorough coverage; other areas where weeds are sparse or clumped will require spot spraying.)

D. Keep truck speed constant when using boom or boomless sprayer

E. Signal truck operator to move as needed when spraying by hand

F. Adjust application rate as needed

(NOTE: Adjust ground speed or operating pressure according to wind conditions, terrain, or other pertinent factors.)

G. Use only clean water

H. Clean line strainer as needed

I. Keep hose straight on drum

(NOTE: Do not allow hose to crisscross on drum. Reel out amount required and lock drum.)

INFORMATION SHEET

J. Flush system when changing chemicals

K. Do not use herbicides if rain is likely

(NOTE: Rain will carry herbicides onto desirable plants.)

L. Keep sprayer clean

(NOTE: Most spray materials are highly corrosive. The most important aspect of long, dependable service is a thorough cleaning of sprayer immediately after each use.)

M. Read and follow instructions on herbicide label

(NOTE: Label will include instructions for storage, mixing proportions, effective coverage, waste and container disposal, and cleaning agents; label will also include any other special instructions, first aid treatment, and antidote.)

SPRAYER NOZZLE

Used with permission of Deere & Company, Moline, Illinois.

SPRAY EQUIPMENT
UNIT V

JOB SHEET #1 — PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A SPRAYER

I. Equipment and materials

A. Sprayer

B. Operator's manual

C. Fuel

D. Manufacturer's recommended lubricants

E. Grease gun

F. Rags

G. Air or water supply

H. Soapy water

I. Small soft brush (old toothbrush)

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Perform prestart inspection and maintenance on truck

B. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

C. Check pump for freedom of rotation

(NOTE: Turn pump by hand. If it turns easily, the pump is ready for use.)

D. Check drive belt for wear, proper tension, and alignment

E. Check safety shields; adjust if needed

F. Check tank for corrosion, scale, and foreign material; clean if needed

G. Check pipe, valve, and hose connections for leaks

JOB SHEET #1

H. Check nozzles for corrosion, obstructions, and wear

(NOTE: On boom sprayer, remove two or three nozzles at different points on the boom and check nozzles and screens.)

I. Check nozzle screens for dirt and wear; replace if needed

J. Clean nozzle tips and screens

(NOTE: Wash tips and screens thoroughly with soapy water and a small soft brush. Clean holes in nozzle tips with water or air pressure. If hole is still clogged, use a wooden toothpick. Do not use a knife, wire, or other hard object to clean nozzle tips. The finely machined surfaces of the tips can easily be damaged, causing distortion of the spray pattern and increase in rate of application.)

(CAUTION: Do not use mouth to blow through screen or nozzle tips.)

K. Check line strainers

L. Check hoses and piping for loose connections; tighten if needed

M. Check all other hoses for kinked, broken, or damaged areas; replace if needed

N. Inspect gauges for damage; check for accuracy; replace if needed

O. Wash hands to remove any herbicide from skin

(CAUTION: Do not smoke before washing hands.)

SPRAY EQUIPMENT
UNIT V

JOB SHEET #2 — CLEAN A SPRAYER

I. Equipment and materials

A. Sprayer

B. Operator's manual

C. Water

D. Tool kit

E. Cleaning materials (detergent, detergent and activated charcoal, or ammonia)

F. Small soft brush (old toothbrush)

II. Procedure

(NOTE: Thoroughly flush tank with water, both inside and out, after each day's use to prevent accumulation of chemicals. Chemicals should not be left in the tank overnight. Cleaning stops corrosion and prevents contamination that may harm desirable vegetation.)

A. Read operator's manual for specific procedures for your machine

B. Completely hose down tank both inside and out

(CAUTION: Dispose of cleaning water where it will not contaminate water supplies, streams, or crops; where it will not injure other plants; and where puddles will not be accessible to children, pets, livestock, or wildlife.)

C. Flush cleaning water through nozzle by operating sprayer

D. Repeat hosing and flushing procedure

E. Remove nozzle tip(s) and screen(s)

F. Clean tips and screens in detergent or ammonia solution, using a soft brush

(NOTE: Clean holes in nozzle tips with water or air pressure. If hole is still clogged, use a wooden toothpick. Do not use a knife, wire, or other hard object to clean nozzle tips. The finely machined surfaces of the tips can easily be damaged, causing distortion of the spray pattern and increase in rate of application.)

(CAUTION: Do not use mouth to blow through screen or nozzle tips.)

JOB SHEET #2

G. Add water to tank — Add 25 gallons water to 300-gallon tank, 100 gallons water to 1,000-gallon tank, 150 gallons water to 1,500-gallon tank

H. Add cleaning materials in correct proportions

1. Add 1 pound detergent per 50 gallons of water, or
2. Add 1 pound detergent plus 1 pound activated charcoal per 50 gallons of water, or
3. Add 1 quart household ammonia per 25 gallons of water

I. Flush entire sprayer system with cleaning solution

J. Fill tank about one-half full of clean water, then flush out through the boom

K. Hose down both inside and outside of tank with clean water

(NOTE: To store sprayer for the winter, add these procedures: remove and store nozzle tips, screens, and strainers in light oil; add antifreeze to the final rinse; lubricate all bearings; change oil in pump; disassemble, clean, lubricate, and reassemble pressure regulator; replace drain plugs tightly to keep insects and mice out of sprayer; check sprayer thoroughly for repairs that need to be made before next spraying operation; and report those needs to proper authority.)

L. Wash hands to remove any herbicide from skin

(CAUTION: Do not smoke before washing hands.)

SPRAY EQUIPMENT
UNIT V

JOB SHEET #3 — SPRAY FOR WEED CONTROL

I. Equipment, materials, and personnel

A. Towed or truck-mounted sprayer

B. Operator's manual

C. Herbicide

D. Herbicide label with formula for mixing

(NOTE: Label must be carried in truck or on container.)

E. Traffic control devices

F. Recommended safety equipment

1. Hard hat
2. Gloves
3. Goggles
4. Respirator
5. Waterproof covering
6. Waterproof boots

G. Truck operator

II. Procedure

A. Read operator's manual for your equipment

B. Fill fluid tank about one-eighth full of water

C. Turn on agitator if unit is so equipped

D. Add chemical required by formula

E. Complete filling the fluid tank with water

(NOTE: This should thoroughly mix the chemical and water.)

F. Road vehicle to work area

JOB SHEET #3

G. Use required traffic control devices

H. Determine wind direction and velocity

(NOTE: If wind is too high, delay starting until it settles down.)

I. Position vehicle on shoulder of road next to target area, headed in the direction most favorable to the wind

(NOTE: Spray downwind with back to wind if possible. Take care not to breathe spray. Check respirator often.)

J. Start and warm up pump engine

K. Open valve, and start spraying back and forth across target area

L. Signal truck operator to move ahead as necessary

M. Continue spraying until designated area is covered

N. Check gauges periodically

O. Perform shutdown procedures for pump

P. Wash hands to remove any herbicide from skin

(CAUTION: Do not smoke before washing hands.)

Q. Move to next job site

SPRAY EQUIPMENT
UNIT V

TEST

NAME _____ SCORE _____

1. Match terms associated with spray equipment to their correct definitions. Write the correct numbers in the blanks.

_____a.	Hand-held nozzle	1. Agitation
_____b.	Pounds per square inch; a standard measure of pressure	2. Application rate
_____c.	Area to be treated	3. Atomization
_____d.	Chemical used for controlling undesirable plants	4. Boom
_____e.	Herbicide droplets blowing away from target area	5. Dispersal rate
_____f.	Mechanical structure used to extend and carry nozzles for a sprayer carrier	6. Sprayer
_____g.	Liquid breakup caused by the tearing action of air	7. Weed control
_____h.	Amount of material sprayed; expressed in gallons per acre (gpa) or pounds per acre, depending on herbicides used	8. Spray gun
_____i.	Machine for controlled delivery of solutions; operates hydraulically	9. Target area
_____j.	Process of stirring or mixing	10. Drift
_____k.	Eradicating weeds and leaving desirable plants along the highway right-of-way	11. Herbicide
_____l.	Amount of material sprayed per unit of time; ounces per minute	12. psi

TEST

2. Match types of sprayers to their correct descriptions/uses. Write the correct numbers in the blanks.

_____a. An off-center flooding nozzle on the side of the rig disperses the herbicide in an arc pattern; used for spraying in rough terrain or around signs and guard rails

_____b. Ropes are soaked with herbicide, then driven over the target area, spreading herbicide on leaves; used for Johnson grass and tall weeds

_____c. A bar equipped with several flat-fan nozzles; used for spraying large areas

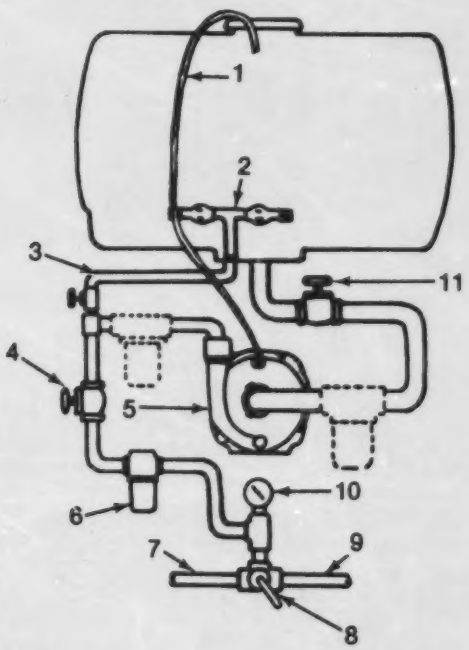
_____d. Operator walks alongside truck and directs hand-held nozzle; used for medians and spot spraying

1. Rope or wick
2. Spray gun
3. Boomless
4. Boom

TEST

3. Identify the parts of a sprayer. Write the correct numbers in the blanks.

_____a.	Boom shutoff or selector	_____g.	Hose to spray gun
_____b.	Jet agitator	_____h.	Agitation line
_____c.	Positive vent line	_____i.	Line strainer
_____d.	Control valve	_____j.	Hose to boom nozzles
_____e.	Pump	_____k.	Tank shutoff
_____f.	Pressure gauge		



4. Match the parts of a sprayer to their correct functions. Write the correct numbers in the blanks. Parts and functions are continued on the next page.

_____a.	Measures discharge rate	1. Nozzle
_____b.	Mixes herbicide and a liquid	2. Pressure gauge
_____c.	Meters herbicide at a certain flow rate, atomizes the liquid into droplets, disperses the droplets in a specific pattern, and propels them for proper impact	3. Agitator

TEST

_____d. Maintains constant pressure

_____e. Keeps foreign material from clogging the spray tip; located inside each nozzle

_____f. Holds from 300 to 1,500 gallons or more

_____g. Prevent foreign materials from plugging the lines

_____h. Controls boom and nozzle functions; mounted in truck cab

_____i. Delivers liquid at a constant pressure over long periods of time

_____j. Transport herbicide to nozzles

4. Hoses
5. Pump
6. Pressure regulator
7. Tank
8. Strainers
9. Screen
10. Control panel

5. State twelve safety rules for operating spray equipment.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

j. _____

k. _____

l. _____

6. Select from the following list factors that affect application rate. Write an "X" in the blank before each correct answer.

_____a. Nozzle distribution

_____b. Location of spray rig in relation to target area

_____c. Speed

TEST

_____d. Humidity

_____e. Terrain

_____f. Location of boom on spray rig

_____g. Type of herbicide

_____h. Wind speed and direction

_____i. Type of liquid mixed with herbicide

_____j. Nozzle pressure

_____k. Fan spray

7. Select from the following list procedures for effective sprayer operation. Write an "X" in the blank before each correct answer.

_____a. Keep sprayer clean

_____b. Vary truck speed as needed when using boom or boomless sprayer

_____c. Spray as conditions require

_____d. Flush system weekly

_____e. Keep hose straight on drum

_____f. Perform prestart inspection and maintenance procedures when convenient

_____g. Clean line strainer weekly

_____h. Apply herbicide at given application rate

_____i. Keep truck speed constant when using boom or boomless sprayer

_____j. Do not use herbicides if rain is likely

_____k. Adjust application rate as needed

_____l. Clean line strainer as needed

_____m. Flush system when changing chemicals

_____n. Work as quickly as possible

_____o. Use only clean water

_____p. Read and follow instructions on herbicide label

_____q. Signal truck operator to move as needed when spraying by hand

TEST

(NOTE: Test question 8 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Demonstrate the ability to

   a. Perform prestart inspection and maintenance procedures on a sprayer.

   b. Clean a sprayer.

   c. Spray for weed control.

SPRAY EQUIPMENT
UNIT V

ANSWERS TO TEST

1.	a.	8	g.	3
	b.	12	h.	2
	c.	9	i.	6
	d.	11	j.	1
	e.	10	k.	7
	f.	4	l.	5

2.	a.	3
	b.	1
	c.	4
	d.	2

3.	a.	8	g.	7
	b.	2	h.	3
	c.	1	i.	6
	d.	4	j.	9
	e.	5	k.	11
	f.	10		

4.	a.	2	f.	7
	b.	3	g.	8
	c.	1	h.	10
	d.	6	i.	5
	e.	9	j.	4

ANSWERS TO TEST

5. Answer should include any twelve of the following

   a. Before operating equipment, attend program on handling herbicides

   b. Read operator's manual thoroughly: know your machine

   c. Study departmental safety manual

   d. Wear protective clothing and equipment

   e. Read herbicide label directions

   f. Carry label or a copy of label in truck to job site

   g. Avoid contact with spray

   h. Keep windows closed

   i. Turn sprayer off when not spraying

   j. Wash off immediately any herbicide that comes in contact with your skin

   k. Do not spray on windy days

   l. Take care that drift does not get on operator, on private property, or on areas used by the public

   m. Keep persons, pets, and livestock away from spray area

   n. Use all required traffic control devices

   o. Wash hands thoroughly before eating

   p. Wash clothes worn for a spraying operation before wearing them again

   q. Do not clean spraying equipment or dump excess spray material near lakes, streams, or ponds

6. b, c, e, h, j

7. a, c, e, h, i, j, k, l, m, o, p, q

8. Performance skills evaluated to the satisfaction of the instructor

SANDBLASTER AND HYDROBLASTER
UNIT VI

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a sandblaster and/or a Hydroblaster safely and effectively. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to

1. Match terms associated with blasting to their correct definitions.
2. Match controls on a typical sandblaster to their correct functions.
3. Identify the parts of a Hydroblaster and a Hydroblaster sand pot attachment.
4. Identify Hydroblaster controls.
5. State safety rules for operating blasting equipment.
6. State procedures for effective blasting.
7. Select from a list procedures for effective sandblasting.
8. Select from a list procedures for effective Hydroblaster operation.
9. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a sandblaster.
    b. Service a sandblaster.
    c. Operate a sandblaster.
    d. Perform prestart inspection and maintenance procedures on a Hydroblaster.
    e. Service a Hydroblaster.
    f. Operate a Hydroblaster.
    g. Remove a paint stripe.

SANDBLASTER AND HYDROBLASTER
UNIT VI

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order materials to supplement unit.

1. Films

a. *Hear What You Want to Hear.* 16 mm, color, 10 minutes, National Safety Council. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, 312/527-4800. Order number 143.03-9.

(NOTE: This film draws employee involvement through audience participation, and encourages use of hearing protection devices.)

b. *Your Body Is Only Human.* 16 mm, color, 10 minutes, National Safety Council. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, 312/527-4800. Order number 147.27-9.

(NOTE: This film investigates the relationship between mind and body in establishing safe work patterns.)

2. Slide show — *It's Your Hearing.* 30 slides, without cassette, National Safety Council. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, 312/527-4800. Order number 176.25-9.

(NOTE: This presentation describes dangers to hearing caused by exposure to excessive noise.)

B. Provide students with objective sheet.

C. Provide students with information and job sheets.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss procedures outlined in job sheets.

G. Provide alternate jobs if those in job sheets are not practical.

H. Arrange a field trip to watch sandblasting and/or hydroblasting operations.

(NOTE: Stress traffic control procedures for this operation.)

I. Review operating procedures and safety precautions for air compressors (Unit II, " Air Compressors and Attachments").

SUGGESTED ACTIVITIES

J. Have students operate controls on dry runs (without pump or power source) to be sure they can shut down equipment quickly.

K. Let students serve as both nozzle operator and machine operator for each job sheet.

L. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1 — Perform Prestart Inspection and Maintenance Procedures on a Sandblaster
2. Job Sheet #2 — Service a Sandblaster
3. Job Sheet #3 — Operate a Sandblaster
4. Job Sheet #4 — Perform Prestart Inspection and Maintenance Procedures on a Hydroblaster
5. Job Sheet #5 — Service a Hydroblaster
6. Job Sheet #6 — Operate a Hydroblaster
7. Job Sheet #7 — Remove a Paint Stripe

E. Test

F. Answers to test

III. Unit references

A. *Maintenance and Operator's Guide: Hydroblaster.* Sparks, Nevada: Fluid Power Sales, Inc., 1977.

B. *Operating and Maintenance Manual, Canned Sand.* Houston, Texas: Schmidt Manufacturing, Inc., n.d.

C. *Operating Instructions, Sand-All Sandblaster.* Miami, Florida: Ace Enterprises, Inc., n.d.

SANDBLASTER AND HYDROBLASTER
UNIT VI

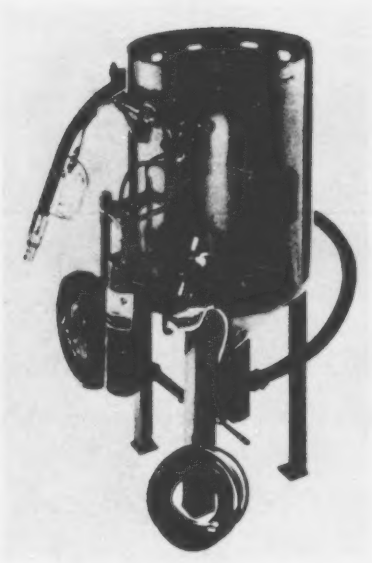
INFORMATION SHEET

I. Terms and definitions

A. Sandblaster — Equipment that delivers sand under high pressure; powered by an air compressor and used for thorough surface cleaning on asphalt, concrete, metal, and paint (Figure 1)

EXAMPLES: Remove paint stripes from road surfaces, and paint and rust from bridges

FIGURE 1



Courtesy of Ace Enterprises, Inc., Miami, Florida.

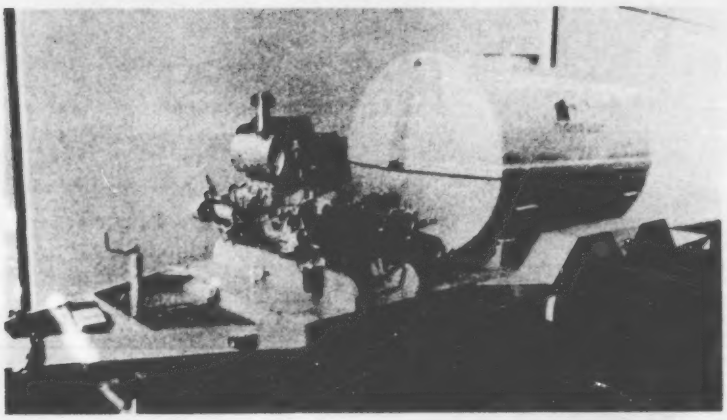
INFORMATION SHEET

B. Hydroblaster — Equipment that delivers water or water and sand under high pressure (Figure 2)

(NOTE: The Hydroblaster is self-contained and used for the same operations as a sandblaster.)

EXAMPLE:

FIGURE 2



Courtesy of Hydroblaster.

C. Sand pot attachment — Device that adapts Hydroblaster to a wet-sand blaster

D. psi — Pounds per square inch; a standard measure of pressure

E. Bleed — To let trapped air escape from a hose or line

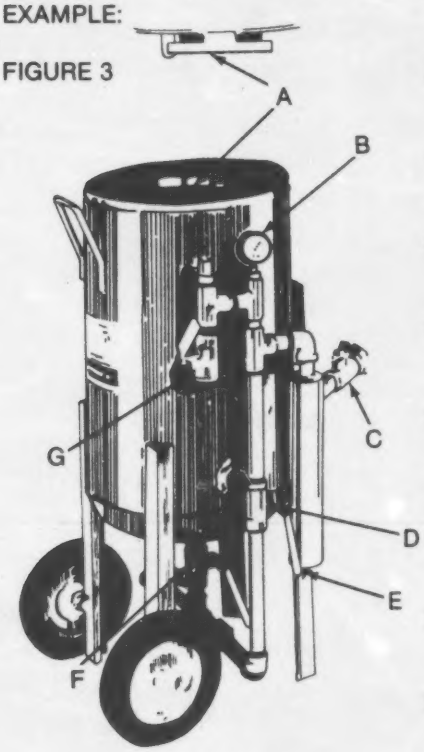
INFORMATION SHEET

II. Controls and their functions on a typical sandblaster (Figure 3; Job Sheets #1-#3)

(NOTE: Controls will vary with manufacturer and model.)

EXAMPLE:

FIGURE 3



A. Sealing valve — Keeps tank airtight so that pressure can build

B. Pressure gauge — Registers air pressure at tank

C. Inlet air valve — Starts and stops pressure; ON/OFF valve

D. Exhaust valve — Relieves pressure at shutdown

E. Choke valve — Increases pressure momentarily

(NOTE: Choke should be in full open position except when added force is needed to clean line.)

F. Sand flow control valve — Controls material flow to nozzle

G. Water trap valve (petcock) — Drains moisture from tank

Used with permission of Ace Enterprises, Inc., Miami, Florida.

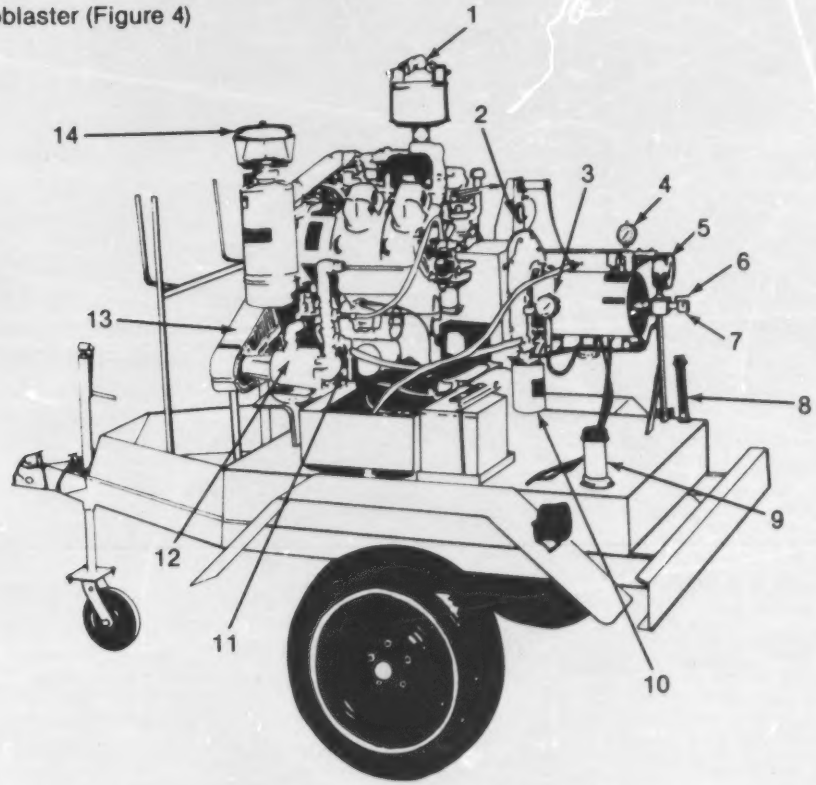
INFORMATION SHEET

iii. Parts of a Hydroblaster and a Hydroblaster sand pot attachment (Job Sheets #4-#6)

(NOTE: Control panel on front of engine, and safety switch and water filters on far side of machine are not shown.)

A. Hydroblaster (Figure 4)

FIGURE 4



Adapted with permission of Fluid Power Sales, Inc., Sparks, Nevada.

1. Exhaust
2. Hourmeter
3. Outlet water pressure gauge
4. Inlet water pressure gauge
5. Tachometer
6. Water outlet
7. Quick coupler hose connection
8. Oil fill
9. Gas fill
10. Oil filter
11. Relief valve

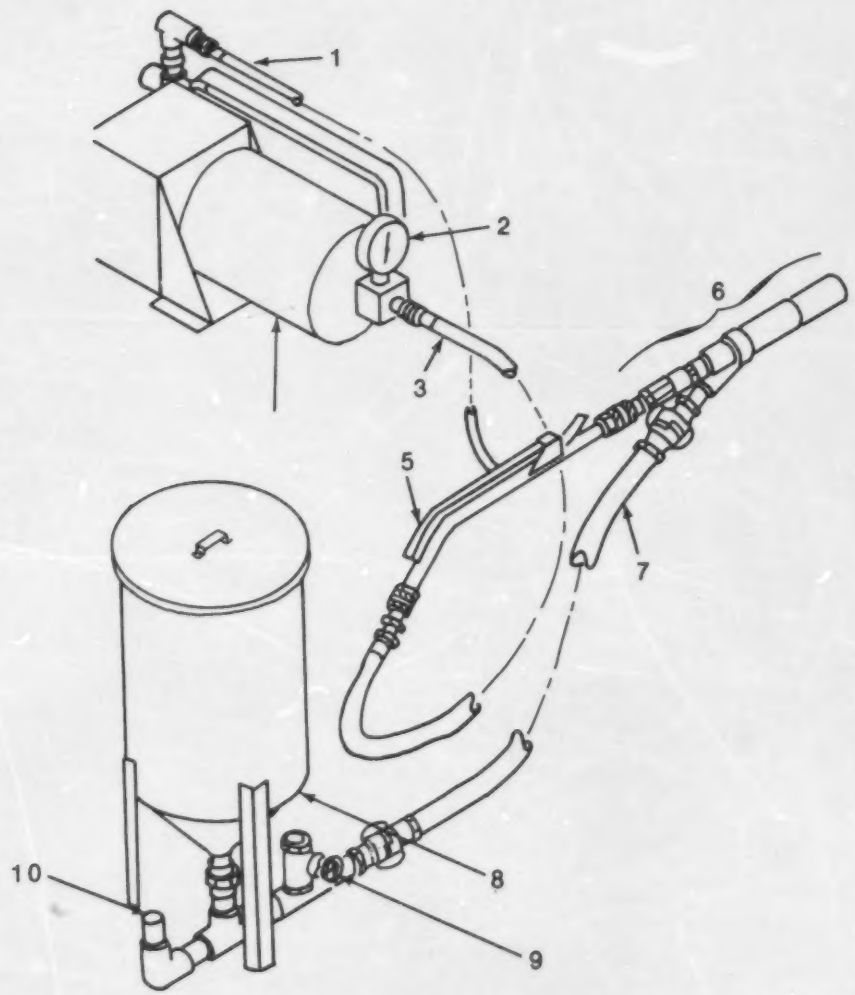
    (NOTE: Valve adjusts maximum water pressure for inlet.)
12. Pump
13. Fan guard
14. Air cleaner

INFORMATION SHEET

B. Hydroblaster sand pot attachment (Figure 5)

1. Control line
2. Pressure gauge
3. High-pressure hose
4. Pump
5. Wand control (trigger)
6. Sand nozzle
7. Sand hose
8. Sand pot
9. Vacuum control valve
10. Air intake

FIGURE 5

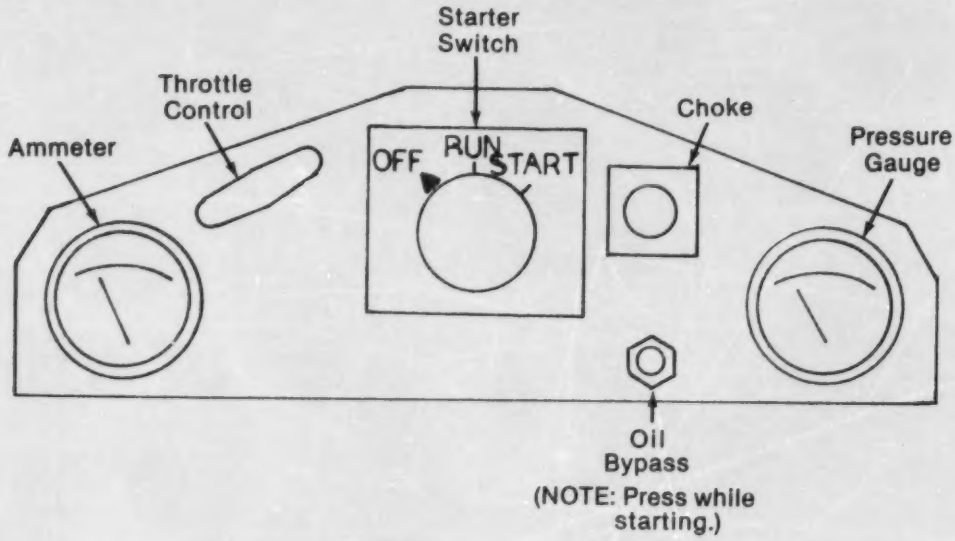


Adapted with permission of Fluid Power Sales, Inc., Sparks, Nevada.

INFORMATION SHEET

IV. Hydroblaster controls (Figure 6; Job Sheet #6)

FIGURE 6



Used with permission of Fluid Power Sales, Inc., Sparks, Nevada.

V. Safety rules for operating blasting equipment (Job Sheets #6 and #7)

(NOTE: Do not accept operating responsibility until you understand the limits and capabilities of your equipment. Blasting operations require a second operator at the machine to cut off the pressure in case of accident.)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Use traffic control devices where needed

D. Wear safety hood

E. Wear protective clothing

EXAMPLES: Leather or heavy coverings, boots, gloves

F. Wear earplugs

G. Be sure area is clear of personnel and equipment before operating

(NOTE: Other persons should be *behind* you during operation.)

INFORMATION SHEET

H. Keep nozzle aimed away from yourself and others

(CAUTION: Jet can cause injury!)

I. Keep hose away from feet and legs

J. Keep hose away from body

(NOTE: Do not allow hose to wrap around your body.)

K. Keep away from sandblaster exhaust

L. Turn engine off before making repairs or adjustments

M. Stop and repair leaks immediately

(CAUTION: Do not operate equipment if machine or hoses leak.)

VI. Procedures for effective blasting (Job Sheet #7)

A. Perform all prestart inspection and maintenance procedures

B. Keep hoses free of kinks

C. Hold nozzle at an angle

(NOTE: Hydroblaster nozzle should be 8 to 10 inches from the surface; sandblaster should be held about waist-high for best control.)

D. Blast so that paint is removed and no groove is cut in the pavement

(NOTE: It is better to leave a thin layer of paint than to damage the road surface.)

E. Work back and forth across the paint stripe, walking forward

F. Keep machine clean

VII. Procedures for effective sandblasting (Job sheet #7)

A. Use only clean, dry material

B. Be sure compressor will supply enough air for size nozzle you are using

(NOTE: Check operator's manual. Allow a 30 percent reserve air supply.)

C. Blow out system before adding material

(NOTE: Connect air pressure hose and clean out system before attaching sandblast hose. This will keep the lines and tank from getting clogged.)

INFORMATION SHEET

D. Use a lean mixture of air and sand

(NOTE: A lean mixture means more air than sand. A heavy, slow-moving mixture will waste sand. The correct mixture will make a whistling sound.)

E. Always open and close sand control valve *slowly*

F. Open inlet air valve *quickly*

(NOTE: This lets the incoming air blow the sealing valve in place. A quick rush of air will set the valve; a slow feed will not.)

G. Adjust sand control valve and pressure as needed for an even flow

(NOTE: To adjust sand control valve, close valve and run machine until sand hose is completely empty, and then reset valve.)

H. Drain water traps twice a day

(NOTE: Some manufacturers suggest leaving the trap slightly open and draining completely once or twice during operation.)

I. Carry spare parts at all times

EXAMPLES: Coupling gaskets, nozzle washers

VIII. Procedures for effective Hydroblaster operation (Job Sheet #6)

A. Use only clean filtered water

B. Check water intake filter frequently during operation

C. Clean tip strainer inside nozzle daily

D. Turn water on *before* operating

E. Bleed hoses before putting on tips

SANDBLASTER AND HYDROBLASTER
UNIT VI

JOB SHEET #1 — PERFORM PRESTART INSPECTION
AND MAINTENANCE PROCEDURES ON A SANDBLASTER

I. Equipment and materials

A. Sandblaster

B. Operator's manual

C. Nozzle

D. Air compressor and air line

E. Coupling gaskets

F. Nozzle washers

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Read operator's manual for your machine

C. Perform prestart inspection and maintenance procedures on air compressor

D. Start and warm up air compressor

E. Check levers and controls for proper functioning on sandblaster

F. Check gauges

G. Check coupling gaskets and nozzle washers for wear; replace if needed

H. Blow out foreign materials in tank or piping

1. Connect air line to air service valve on tank

2. Close exhaust valve

3. Place choke valve in closed position

4. Place sand control valve in full open position

JOB SHEET #1

5. Open service valve on air compressor
6. Open inlet air valve on sandblaster
7. Blow out tank through sand control valve
8. Open and close check valve repeatedly for ten seconds
9. Close inlet air valve
10. Place choke valve in full open position
11. Close service valve on air compressor

I. Check moisture trap; open and allow to dry if moisture is present

J. Check hose and nozzle for wear; repair or replace if needed

SANDBLASTER AND HYDROBLASTER
UNIT VI

JOB SHEET #2 — SERVICE A SANDBLASTER

I. Equipment and materials

A. Sandblaster

B. Operator's manual

C. Coupling gaskets

D. Nozzle washers

E. Tool kit

F. Replacement parts

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacement should be reported to the proper authority and completed by a trained mechanic.)

B. Check screen for holes and wear; clean and repair or replace if needed

C. Check couplings for wear and properly fitting hose; repair if needed

D. Check coupling gaskets for wear; replace if needed

E. Check nozzle washers for wear; replace if needed

F. Check sand control valve for wear; repair or replace if needed

G. Check sealing gasket at sand fill hole for possible leakage; replace immediately if necessary

H. Check exhaust valve for wear; replace if needed

I. Check condition of tires

J. Check condition of hose; repair weak places or leaks immediately

SANDBLASTER AND HYDROBLASTER
UNIT VI

JOB SHEET #3 — OPERATE A SANDBLASTER

I. Equipment, materials, and personnel

- A. Sandblaster
- B. Operator's manual
- C. Nozzle and hose
- D. Air compressor and air line
- E. Blasting sand
- F. Nozzle operator
- G. Machine operator

  (NOTE: Perform all procedures in this job sheet. Do not operate nozzle without another person at the machine.)

- H. Recommended safety equipment
  1. Sandblaster hood
  2. Heavy gloves
  3. Boots
  4. Protective clothing
  5. Respirator
  6. Hearing protection

II. Procedure

- A. Read operator's manual thoroughly
- B. Perform all prestart inspection and maintenance procedures on sandblaster and on air compressor
- C. Start and warm up air compressor
- D. Blow out foreign material from tank and piping

JOB SHEET #3

E. Set valves

1. Close inlet air valve
2. Close sand control valve
3. Open choke valve completely

F. Attach sandblasting hose

G. Fill sand pot

(NOTE: Be sure mesh screen is in place and in good condition. Mesh must be correct size for the sand you are using.)

H. Close exhaust valve

I. Check all couplings; make sure they are secure

J. Open service valve on compressor

K. Open inlet air valve on sandblaster *quickly*

(NOTE: This lets the incoming air blow the sealing valve in place.)

L. Let tank reach operating pressure

M. Slowly open sand control valve at bottom of tank until sand flows into air stream; let the flow even out for a few seconds

N. Gradually close sand control valve until sand stops

O. Reopen valve slightly until sand flows again

(CAUTION: Always open and close sand control valve slowly.)

P. Hold nozzle at an angle, 8 to 10 inches from the surface

Q. Work nozzle back and forth across work area

R. Practice until you have control of the nozzle

S. Stop blasting

1. If nozzle is equipped with a valve, release valve
2. If there is no nozzle valve, close inlet air valve and *immediately* open exhaust valve

(NOTE: Under most circumstances the nozzle operator will signal the machine operator to shut off the air supply.)

JOB SHEET #3

T. Close service valve at compressor

U. Shut down compressor

V. Open relief valve on compressor if compressor is so equipped

W. Disconnect sandblasting hose from tank

X. Disconnect air hose from compressor

Y. Clean hose and nozzle; store in their proper places

SANDBLASTER AND HYDROBLASTER
UNIT VI

JOB SHEET #4 — PERFORM PRESTART INSPECTION
AND MAINTENANCE PROCEDURES ON A HYDROBLASTER

I. Equipment and materials

A. Hydroblaster

B. Operator's manuals for Hydroblaster and engine

C. Engine oil

D. Engine coolant

E. Hydraulic oil, 30 wt., nondetergent

F. Fuel

G. Lubricants

H. Grease gun

I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level; add or change oil if needed

C. Check engine coolant level; add coolant if needed

D. Check hydraulic pump oil reservoir level; add oil if needed

E. Check fuel level; fill tank if necessary

F. Check battery connections for tightness and corrosion

G. Check battery electrolyte level; add water if needed

H. Check air cleaner; remove and clean filter if necessary

I. Check tires

JOB SHEET #4

J. Clean all grease fittings and lubricate according to operator's manual

K. Check drive belts for tightness

L. Check electrical wire connections and insulation

M. Check gauges

N. Check levers and controls for proper functioning

O. Check lights

P. Check safety devices

Q. Check other components

(NOTE: Do not adjust revolutions-per-minute setting. It is preset and should not exceed 1,800 rpm.)

1. Clean tip strainer; check for wear

2. Check water intake filter; replace if necessary

SANDBLASTER AND HYDROBLASTER
UNIT VI

JOB SHEET #5 — SERVICE A HYDROBLASTER

I. Equipment and materials

A. Hydroblaster

B. Operator's manual

C. Tool kit

D. Air supply

E. Grease gun

F. Lubricants

G. Cleaning solvents

H. Rags

I. Water

J. Engine coolant

K. Engine oil

L. Hydraulic oil, 30 wt., nondetergent

M. Replacement parts

N. Tire pressure gauge

O. Fuel

II. Procedures

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

JOB SHEET #5

C. Check engine coolant level, radiator cap, hoses, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filter; replace if needed

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check drive belts for tension and wear; adjust or replace if needed

I. Check wiring, insulation, and connections

J. Clean and lubricate all grease fittings according to operator's manual

K. Check condition of tires

L. Check tire pressure; inflate to recommended pressure

M. Check all safety devices; repair as needed

N. Check other components

1. Clean tip strainer; check for wear; replace if needed
2. Check water intake filter; replace if needed
3. Check tips for wear; replace if needed
4. Check hoses and couplings for wear

SANDBLASTER AND HYDROBLASTER
UNIT VI

JOB SHEET #6 — OPERATE A HYDROBLASTER

I. Equipment, materials, and personnel

A. Hydroblaster with hoses and nozzles

B. Operator's manual

C. Water source

D. Recommended safety equipment and protective clothing

1. Safety shield

2. Ear protection

3. Waterproof covering

4. Rubber boots

E. Machine operator

F. Nozzle operator

(NOTE: Perform all procedures in this job sheet. Do not operate nozzle without another person at the machine.)

II. Procedure

A. Read operator's manual thoroughly

B. Perform all prestart inspection and maintenance procedures

C. Attach intake water hose to Hydroblaster and to water source

(CAUTION: Use only clean water. Dirty water will cause pump failure.)

D. Connect high-pressure hose and wand without nozzle

E. Connect hose to pump

(NOTE: Be sure hose couplers are connected securely

F. Connect wand ON/OFF control system to fitting

(NOTE: Do not connect nozzle now.)

JOB SHEET #6

G. Turn on intake water

H. Start and warm up engine for five minutes

1. Hold oil bypass button down

2. Turn start switch

(CAUTION: Do not start engine unless water supply is flowing through pump. Boost and high-pressure pumps should not be run dry.)

I. Allow normal intake pressure to run through hose without nozzle

(NOTE: This procedure "bleeds" the line, removing trapped air and allowing water to flow evenly.)

J. Shut off engine

K. Shut off water supply

L. Attach nozzle to wand and connect sandblaster fittings according to operator's manual

(NOTE: Be sure no dirt or sand gets into fittings or nozzle. All quick couplers should be connected securely

M. Put on face shield and ear protection

N. Check hose placement for kinks; keep hose away from your feet and body

O. Turn on intake water

P. Open valve all the way

Q. Hold wand firmly to prevent injury

R. Restart engine

S. Pull throttle out all the way

T. Press down on wand control handle

U. Move wand slowly back and forth over surface until you feel that you have control over it

V. Release wand control

(NOTE: This will deactivate the pressure.)

JOB SHEET #6

W. Shut down Hydroblaster by pushing in throttle and turning off engine switch

X. Press wand control to release pressure from line

Y. Shut off water

SANDBLASTER AND HYDROBLASTER
UNIT VI

JOB SHEET #7 — REMOVE A PAINT STRIPE

I. Equipment, materials, and personnel

A. Hydroblaster or sandblaster and compressor with hose

B. Operator's manual

C. Water

D. Blasting sand

E. Traffic control devices

F. Recommended safety equipment and protective clothing

1. Safety hood

2. Waterproof covering

3. Rubber boots

4. Earplugs

G. 4" x 4" x 18" wood blocks

H. Nozzle operator

I. Machine operator

(NOTE: Perform all procedures in this job sheet. Do not operate nozzle without another person at the machine.)

II. Procedure

A. Perform all prestart inspection and maintenance procedures

B. Place traffic control devices

C. Park machine close to paint line, where hoses will not kink at close range and where hoses will reach the required length without straining

D. Block wheels

E. Perform starting and warm-up procedures

F. Put safety hood on

JOB SHEET #7

G. Connect hoses

(CAUTION: Shut down Hydroblaster engine before connecting nozzle.)

H. Set control valves

1. Hydroblaster

   a. Turn on intake water

   b. Open valve all the way

2. Sandblaster

   a. Close exhaust valve

   b. Open choke valve all the way

   c. Close sand control valve

      (NOTE: Hold nozzle in hand, pointed away from you and other personnel and away from the work to be blasted.)

   d. Open inlet air valve *quickly*

   e. Slowly open sand control valve; let flow even out for a few seconds

   f. Gradually close sand control valve until sand stops

   g. Reopen valve slightly until sand flows at desired amount

I. Stand where line is to be removed

J. Hold nozzle at an angle to line

K. If material is not already flowing, press down on nozzle control

L. Work back and forth across the line, walking forward

(NOTE: Keep jet spray moving at a rate that will remove the paint without cutting a groove in the pavement. It is better to leave some paint than to cut into the surface.)

M. Check Hydroblaster intake filter during operation; open sandblaster water traps

N. Release wand control; reduce pressure to zero

O. Perform shutdown procedures

P. Clean hoses and nozzle; store in their designated places

SANDBLASTER AND HYDROBLASTER
UNIT VI

TEST

NAME _____ SCORE _____

1. Match terms associated with blasting to their correct definitions. Write the correct number in the blanks.

_____a.	Pounds per square inch; a standard measure of pressure	1. Hydroblaster
_____b.	To let trapped air escape from a hose or line	2. Sand pot attachment
_____c.	Equipment that delivers water or water and sand under high pressure	3. psi
_____d.	Device that adapts Hydroblaster to a wet-sand blaster	4. Sandblaster
_____e.	Equipment that delivers sand under high pressure; powered by an air compressor and used for thorough cleaning on asphalt, concrete, metal, and paint	5. Bleed

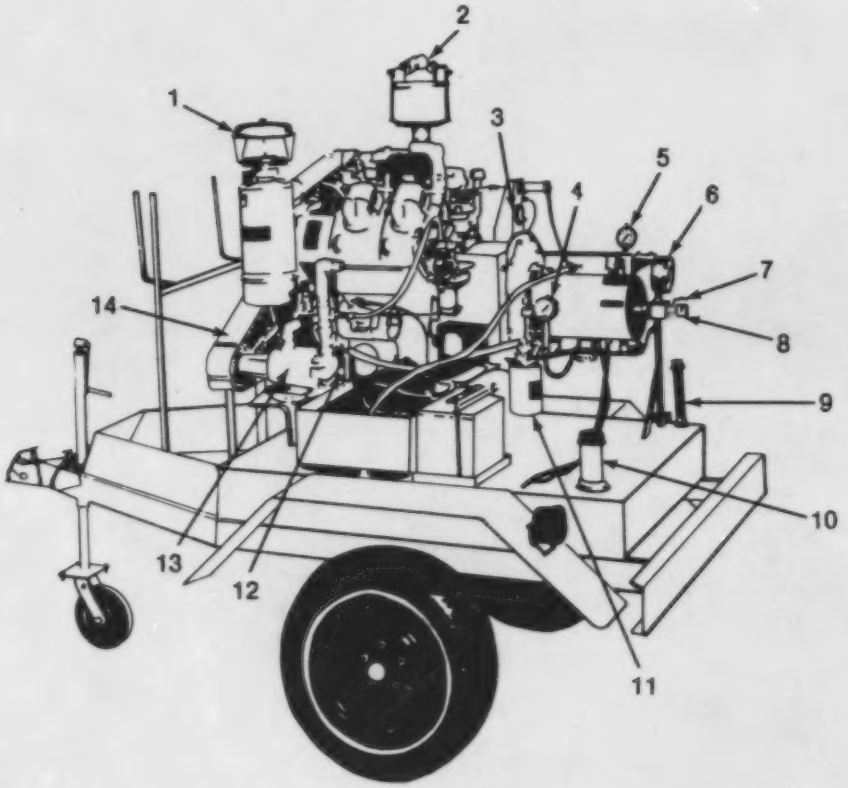
2. Match controls on a typical sandblaster to their correct functions. Write the correct numbers in the blanks.

_____a.	Increases pressure momentarily	1. Choke valve
_____b.	Starts and stops pressure; ON/OFF valve	2. Pressure gauge
_____c.	Keeps tank airtight so that pressure can build	3. Water trap valve (petcock)
_____d.	Drains moisture from tank	4. Sand flow control valve
_____e.	Registers air pressure at tank	5. Sealing valve
_____f.	Relieves pressure at shutdown	6. Inlet air valve
_____g.	Controls material flow to nozzle	7. Exhaust valve

TEST

3. Identify the parts of a Hydroblaster and a Hydroblaster sand pot attachment. Write the correct numbers in the blanks.

Hydroblaster



_____a. Oil filter

_____b. Hourmeter

_____c. Fan guard

_____d. Exhaust

_____e. Gas fill

_____f. Outlet water pressure gauge

_____g. Relief valve

_____h. Water outlet

_____i. Inlet water pressure gauge

_____j. Pump

_____k. Air cleaner

_____l. Tachometer

_____m. Quick coupler hose connection

_____n. Oil fill

TEST

Hydroblaster sand pot attachment

_____a. Sand pot

_____b. Sand nozzle

_____c. Control line

_____d. Air intake

_____e. Pump

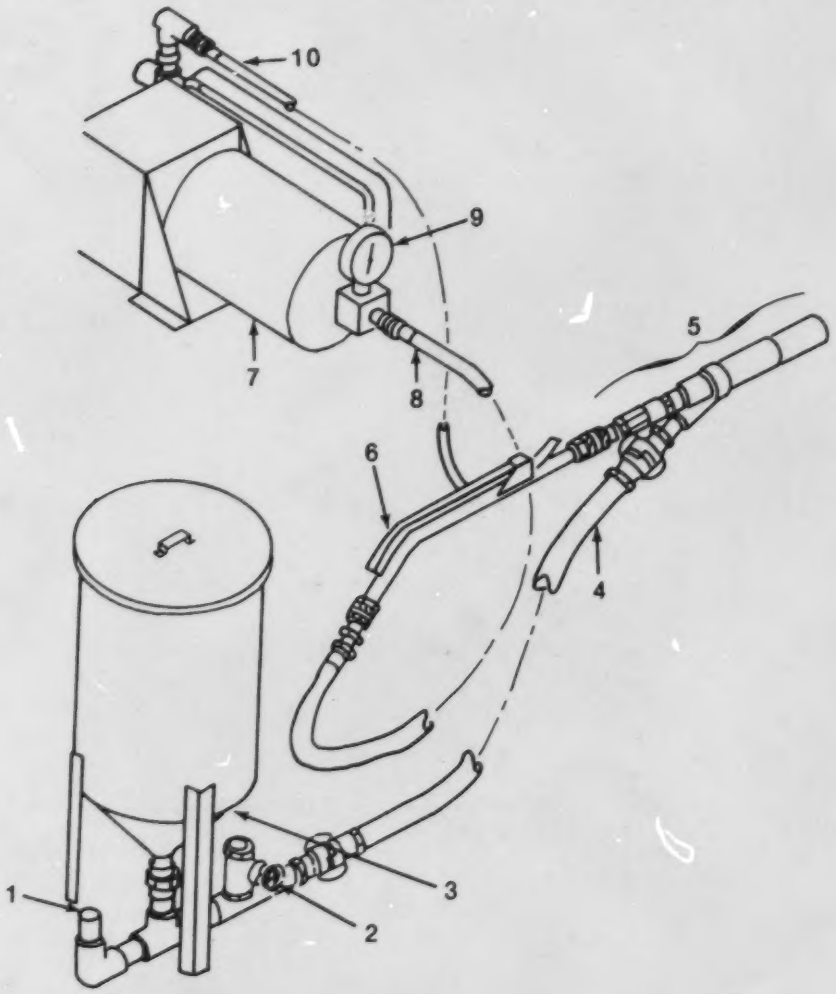
_____f. Pressure gauge

_____g. Wand control (trigger)

_____h. Sand hose

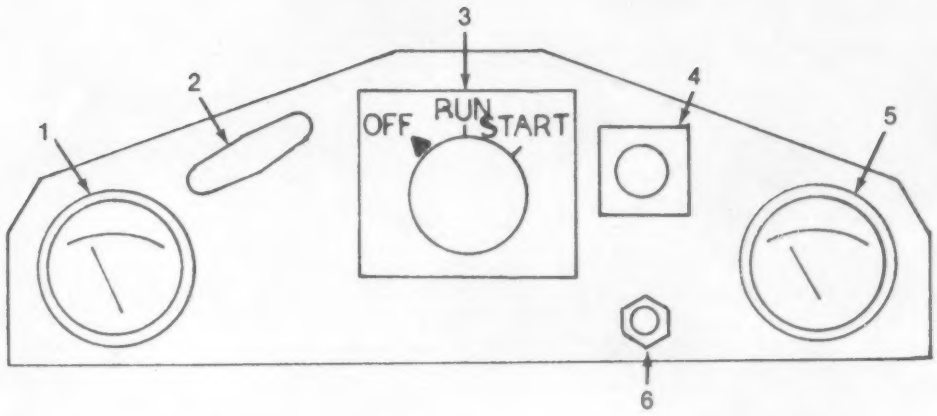
_____i. Vacuum control valve

_____j. High-pressure hose



TEST

4. Identify Hydroblaster controls. Write the correct numbers in the blanks.



_____a. Choke

_____b. Throttle control

_____c. Oil bypass

_____d. Starter switch

_____e. Pressure gauge

_____f. Ammeter

5. State six safety rules for operating blasting equipment.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

TEST

6. State four procedures for effective blasting.

   a. _____

   b. _____

   c. _____

   d. _____

7. Select from the following list procedures for effective sandblasting. Write an "X" in the blank before each correct answer.

   _____a. Use only clean, dry material

   _____b. Use a lean mixture of air and sand

   _____c. Allow a 5 percent reserve air supply

   _____d. Blow out system before adding material

   _____e. Always open and close sand control valve *slowly*

   _____f. Always open and close sand control valve *quickly*

   _____g. Be sure compressor will supply enough air for size nozzle you are using

   _____h. Carry spare parts at all times

   _____i. Open inlet air valve *quickly*

   _____j. Open inlet air valve *slowly*

   _____k. Adjust pressure if nozzle makes a whistling sound

   _____l. Adjust sand control valve and pressure as needed for an even flow

   _____m. Drain water traps twice a day

8. Select from the following list procedures for effective Hydroblaster operation. Write an "X" in the blank before each correct answer.

   _____a. Use pond water whenever possible

   _____b. Turn water on *before* operating

   _____c. Turn water on *after* turning sand on

TEST

_____d. Check water intake filter daily

_____e. Bleed hoses before putting on tips

_____f. Clean tip strainer inside nozzle weekly

_____g. Use only clean filtered water

_____h. Clean tip strainer inside nozzle daily

_____i. Check water intake filter frequently during operation

_____j. Bleed hoses frequently

(NOTE: Question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Perform prestart inspection and maintenance procedures on a sandblaster.

   b. Service a sandblaster.

   c. Operate a sandblaster.

   d. Perform prestart inspection and maintenance procedures on a Hydroblaster.

   e. Service a Hydroblaster.

   f. Operate a Hydroblaster.

   g. Remove a paint stripe.

SANDBLASTER AND HYDROBLASTER
UNIT VI

ANSWERS TO TEST

1. a. 3 d. 2
   b. 5 e. 4
   c. 1

2. a. 1 e. 2
   b. 6 f. 7
   c. 5 g. 4
   d. 3

3. Hydroblaster

a.	11	h.	7
b.	3	i.	5
c.	14	j.	13
d.	2	k.	1
e.	10	l.	6
f.	4	m.	8
g.	12	n.	9

Hydroblaster sand pot attachment

a.	3	f.	9
b.	5	g.	6
c.	10	h.	4
d.	1	i.	2
e.	7	j.	8

4. a. 4 d. 3
   b. 2 e. 5
   c. 6 f. 1

5. Answer should include any six of the following

   a. Read operator's manual thoroughly: know your machine

   b. Study departmental safety manual

ANSWERS TO TEST

c. Use traffic control devices where needed

d. Wear safety hood

e. Wear protective clothing

f. Wear earplugs

g. Be sure area is clear of personnel and equipment before operating

h. Keep nozzle aimed away from yourself and others

i. Keep hose away from feet and legs

j. Keep hose away from body

k. Keep away from sandblaster exhaust

l. Turn engine off before making repairs or adjustments

m. Stop and repair leaks immediately

6. Answer should include any four of the following

   a. Perform all prestart inspection and maintenance procedures

   b. Keep hoses free of kinks

   c. Hold nozzle at an angle

   d. Blast so that paint is removed and no groove is cut in the pavement

   e. Work back and forth across the paint stripe, walking forward

   f. Keep machine clean

7. a, b, d, e, g, h, i, l, m

8. b, e, g, h, i

9. Performance skills evaluated to the satisfaction of the instructor